ELECTRICAL REVIEW

and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT

VOL. LXII, No. 24. CHICAGO, SATURDAY, JUNE 14, 1913. ISSUED WEEKLY.

COMPRISING

ELECTRICAL REVIEW WESTERN ELECTRICIAN ELECTROCRAFT

ELECTRICAL REVIEW PUBLISHING COMPANY

608 SOUTH DEARBORN STREET
CHICAGO

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SUBSCRIPTIONS.

One Year, United States.....$3.00
One Year, Canada..... 4.00
One Year, Foreign Countries..... 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each .25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

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DISTRICT HEATING.

The progress of the central station in acquiring a connected load in small manufacturing plants has been very marked ever since this form of customer was first solicited. While there remain in many communities ample opportunities for still further enlarging the load in this direction, there are others where the solicitation has been so complete and efficient that saturation is being approached. This does not mean that there will not be any further increase in business in this class, since the natural growth of most manufacturing towns and cities will continue to furnish new opportunities for increasing the connected load. Neither does it mean that all the manufacturing plants in such communities have been secured as customers for the central station, because there are a large number, especially among the larger industrial establishments, which are so wedded to the isolated plant that they will not consider an offer from the central station or whose requirements are of such a nature that the central station is not in a position to make them an attractive offer. In the latter category are included many plants where the heating problem presents the main obstacle to the use of central-station power. The use of exhaust steam from their engines for this purpose dovetails too well with the home generation of power to be supplanted by a central-station supply unless some other satisfactory provision can be made for this item. The natural answer to this problem is for the central station itself to supply heating as well as power to such factories. Where the building lies within reasonable proximity to the power plant this is entirely feasible for the central station and is an activity which forms a natural development in the complete centralization of power generation.

Many central stations over the country are already supplying steam or hot-water heat to their customers as well as electric current, and since steam is a natural by-product of the manufacture of power, this is an entirely rational extension of their operations. The combined supply of heat and power offers many opportunities which the supply of power alone cannot realize. There have been complaints from many quarters that the supply of heating for buildings is not profitable, but this generally arises from mismanagement or the lack of a rational basis of charging. Just as in the supply of electric energy a flat rate encourages waste and extravagance and is not suited for supply upon any but a small scale, so in the case

of steam heating the most satisfactory results are obtained when charges are placed upon a meter basis.

This was prominently brought out at the convention of the National District Heating Association, which took place during the last week in May and is reported upon other pages of this issue. Much greater economy of operation is shown in nearly all cases where a change has been made from a flat rate to a meter rate as a basis of charging, and with the latter system general satisfaction has been felt by the central station as well as by the customer when he understands the situation. District heating, as stated above, is a natural adjunct to the supply of power and its adoption can be relied upon to furnish an increase in the extension of central-station service.

TEACHING THE PUBLIC PROPER TERMINOLOGY.

Electrical subjects have long been clothed with an atmosphere of mystery in the eyes of the general public and this has not been greatly lessened through the general familiarity with the electric lamp and the telephone. The why's and wherefore's of electrical apparatus are usually incomprehensible to the mind of the layman and the language of the electrical engineer a little worse than Greek.

Even in those terms where the public comes in contact with the business office of the central-station company there cannot be said to be general understanding. The kilowatt-hour, for instance, is a vague and uncertain thing in the mind of the average customer, and even though his bills may be made out in terms of this unit, he is usually in blissful ignorance of just what the unit represents. This ignorance is largely enhanced through the loose way in which many persons, not excluding central-station officials, speak of electrical energy. Since the demand of a connected load is usually expressed in watts or kilowatts, the time element in the representation of energy consumed is easily overlooked and we often see energy spoken of in terms of kilowatts. This use of the word is not confined to those who have an excuse for ignorance of the matter, but it may even be seen upon the bills of some electric light companies where the kilowatt-hour consumption will be charged as so many kilowatts.

Such a condition does not tend to clarify the situation in the mind of the average customer, and, indeed, how can we ever expect him to get the subject straight when those who are making a business of dealing in this commodity use terms wrongfully and in a way which only tends to confuse him? Not only should central-station officials make it a point to have this distinction appear properly upon all their printed matter, but they should make an effort in giving material to newspaper reporters to get it straight in the public press. A proper distinction between energy and maximum demand or power is essential to a proper appreciation in the mind of the customer of the basis of even the simplest rates.

FOR SHORTER PROGRAMS AND MORE DISCUSSION.

The announcement of the plans for the Pacific Coast meeting of the American Institute of Electrical Engineers elsewhere in this issue contains a suggestion which it would be well for other organizations to seriously consider. This meeting is to be held at Vancouver, B. C., in September, and the committee has decided to have a single paper presented at each one of the sessions, thus allowing ample opportunity for discussion.

It has become customary with many society conventions of late years to so fill the program with committee reports and papers that there is a grand rush to keep on schedule and dispose of all of the papers on the program within the specified time. The chairmen feel that it is necessary to restrict discussion to a minimum and instead of members being encouraged to participate, the atmosphere is usually one of discouragement. This applies more particularly to the large associations which have no difficulty in securing material for their meetings, and it was conspicuously the case at some of the sessions of the convention of the National Electric Light Association last week.

There are two principal objects to be attained in conventions of the type here under consideration. One of these is the personal intercourse and contact which does so much to broaden the intellectual horizon of those attending, and the other is the contribution from every-day occurrences and personal experience which is brought out in the discussion of papers and reports. The first of these objects is best attained by not having the time too greatly taken up with formal sessions. The second is to be attained by devoting as much of the time in the sessions, as possible, to discussion.

Where papers are printed the only object in having them presented in the meeting is to form a basis for discussion, since the information contained in the paper can be just as readily acquired by reading at home. In order to dispense with the reading of a paper in full, however, it is necessary that printed copies be supplied to members in advance, and this is too frequently not the case. Even among those societies which print their papers, they are often not available until immediately before the convention, and if this convention is a large one there is not time to read all of the papers beforehand. By reducing the number of papers it would not only be possible to give them more attention beforehand, but it would be possible for the secretary's office, which is commonly overworked at this period, to have the printing done earlier. Many papers, however, cannot be printed much in advance owing to the delinquency of the author or committee in supplying the manuscript. It would be well in such cases as this to hold the paper over for a future meeting and this would not only help to prevent crowding of the program but would provide a nucleus of papers printed

well in advance for the next succeeding meeting.

With the number of papers limited it would be possible for the committee in charge to select for the program those which are most suitable for discussion and most likely to interest the members and bring forth expressions of opinion from various sources. Papers are often presented which are valuable in themselves but not of a nature that is well suited for oral discussion or likely to call it forth, and it would be better to print such papers in the *Transactions* of the society without presentation at a meeting. With the number of papers closely limited it should not be a difficult matter for the committee in charge to secure sufficient material at an advance date to permit printing and distribution in ample time before the meeting.

Further attention to these considerations would tend to greatly increase the value of the conventions of such bodies as the National Electric Light Association, the American Institute of Electrical Engineers, and some of the larger state associations of public utility companies.

KEEPING IN TOUCH WITH CUSTOMERS.

For some unaccountable reason there seems to be a dire lack of what in sales phraseology is known as missionary work on the part of central-station companies, although no company is ready to admit that it does not appreciate the importance of keeping closely in touch with customers, after the contract for service has been signed. Only a few of the larger companies can afford to employ men whose time can be devoted to visits of inspection to existing customers exclusively. But it can be stated, without fear of contradiction, that the time of no salesman is so occupied in obtaining new business that he cannot spare time to visit at least one or two customers each day.

Aside from the value of such visits to the central station, in that they imbue the customer with the idea that the company is interested beyond the mere collection of the monthly bill, they serve as a means of stimulating future sales in motors and appliances, and what is of greater importance, often adjust minor complaints before these develop to the point where they are reported at the office—grievances, nevertheless, which would have been held against the company, perhaps with unpleasant consequences.

A textile manufacturer located in an eastern city had installed a modern equipment of motors, purchasing power from the local electric company. After 8 or 10 months' operation, additional textile machines were added and changes made in the motor equipment by the mill superintendent to take care of the additional load. Some time later an agent of isolated-plant equipment interested the manufacturer in generating his own power, which he guaranteed could be done at less than present costs. The central-station manager first learned of this action when he visited the textile mill to show the installation to a visitor. Upon investigation of the high consumption he learned that the additional machines were being driven from a motor which also operated a large group of machines that were seldom used. By a visit to this plant at the time when the machines were added, with a suggestion that an additional motor be purchased to drive the new machines, a profitable customer could undoubtedly have been retained.

This is simply one of the many instances that could be cited to illustrate the importance of making periodic calls on existing customers. Surely the results of such visits justify the small expense involved.

EDUCATING THE SALESMAN.

There was a time when the business of selling products or service of any sort consisted mainly of taking the orders and delivering the goods. The prevailing type of salesman was only an order taker, and the then exceptional type of man who kept up a systematic search for possible customers and was aggressive and energetic in his efforts to convince these of the merits of what he had to sell was often regarded as more or less of a nuisance by the public. But there has lately been a fortunate change of attitude both on the part of the manufacturer and other producers and on that of the public. Just how this came about it would doubtless be difficult to say. It is probable, though, that the increasing keenness of competition had much to do with the awakening of the producer to the best methods of marketing his wares, while without doubt the improvement in the quality of salesmen has been the most effective factor in converting the public to a saner attitude towards men who solicit orders.

The producer is rapidly coming to realize that one of the most important steps in legitimate selling is the making plain to the prospective customer, in an honest, straightforward way, the real advantages of the thing offered for sale, and he is training his salesmen to do this. Money spent in such training is usually most wisely spent. This seems to be the unanimous testimony of the electrical concerns that have tried it. There was testimony of this sort at the recent convention of the National Electric Light Association by representatives of central stations and electrical manufacturing concerns that are conducting schools for their solicitors and salesmen.

It might appear that the regular schools and colleges of the country ought to provide the sort of training required for this work. It is hardly probable that they will ever be able to do this. The salesman for almost any electrical concern needs an acquaintance with the company's products and methods more intimate than it is usually possible to secure in a satisfactory measure outside of the organization itself.

No selling ought to be a confidence game. If the salesman does not know his wares, selling electrical material or service can be but little more than that.

Pacific Coast Convention of Electrical Engineers.

The president of the American Institute of Electrical Engineers has appointed a Convention Committee to make arrangements for the Pacific Coast Convention, to be held in Vancouver, B. C., September 9 to 11. The chairman of this committee is R. F. Hayward and the secretary is E. M. Breed.

The chairman of the Vancouver Section has appointed a number of local committees to prepare for the convention. The chairmen of these are as follows:

General Committee, R. F. Hayward.

Committee on Papers, F. D. Nims.

Committee on Transportation, E. M. Breed.

Committee on Entertainment, L. G. Robinson.

Committee on Finance, William Mc Neil.

A tentative program has been arranged by the Papers Committee, which plans to have only one paper presented at each session, thus giving opportunity for comprehensive discussion.

Following the regular sessions of the convention, trips have been arranged for the two following days to the hydro-electric development of the Western Canada Power Company at Stave Falls and to that of the Vancouver Power Company at Lake Buntzen.

Tenth Anniversary of the Public Service Corporation of New Jersey.

The tenth anniversary of the formation of the Public Service Corporation of New Jersey was celebrated June 2 by the tendering of a testimonial banquet to President Thomas N. McCarter, at Delmonico's, New York. The occasion was marked by many addresses citing references to the development and activities of the corporation during the past decade under the guidance of Mr. McCarter, during which period $70,000,000 has been expended to upbuild and improve the utilities it controls.

Mr. McCarter was the recipient of a handsome silver punchbowl and tray, the latter being engraved upon its outer edge with fac-simile signatures of the directors of the corporation, who were the donors. On the four panels of the bowl were etched symbolical references of the company's utilities,—a trolley car, a gas holder, a miniature of the Marion power station and the Public Service emblem. The presentation address was made by Frank Bergen, director and general counsel of the corporation.

Walton Clark, a director, acted as toastmaster for the evening. Addresses were made by President McCarter, Directors Randal Morgan, Uzal H. McCarter, J. P. Dusenberry, W. C. Heppenheimer, Forrest F. Dryden, Dudley Farrand, Samuel T. Bodine and Howard MacSherry.

The corporation operates the Public Service Electric Company, the Public Service Gas Company and the Public Service Railway Company. It serves a total of 202 municipalities in New Jersey, with an aggregate population of 2,028,947 persons.

Boston Motor Club Meeting.

The results of the recent convention of central stations, electric-vehicle dealers and manufacturers were discussed at the meeting of the Electric Motor Car Club of Boston, at the Hotel Thorndike, on June 5. A substantial cash balance was reported, which the Club voted to use in further publicity.

Secretary O. G. Draper reported that Club advertising costing more than $1,000 had been used in Boston newspapers this spring, in which various manufacturers shared proportionately. Charging stations in New England to the number of 201 are on record, but there are further additions to be made as they may be reported. Central stations having public charging facilities are requested to notify the secretary. Electric vehicles registered in Massachusetts number 833, of which 483 are passenger cars and 350 trucks.

It was voted to request the New England Section, National Electric Light Association, to include a paper on electric vehicles in the program of the convention to be held in Burlington, Vt., in September.

Kansas Public Service Association.

The Executive Committee of the Kansas Gas, Water, Electric Light and Street Railway Association has decided to recommend that the Association change its name to Kansas Public Service Association. The necessary changes in the constitution and by-laws will be submitted at the next annual convention. As the Association represents other utilities than those supplying electric light and power it was thought advisable to continue as an individual association rather than to affiliate with the National Electric Light Association.

It will also be recommended that the membership be divided into three classes. Class A shall consist of utility companies and representatives of municipally operated plants. Class B shall consist of employees of member companies and of manufacturers, jobbers, contractors, etc. Class C shall consist of honorary members.

Electrical Exports for April.

The Bureau of Foreign and Domestic Commerce, Washington, D. C., has issued its monthly summary of the imports and exports of the United States for April. From this source are obtained the following facts relative to the electrical exports.

What seemed to be a very striking electrical-export record established last March has been exceeded by the total shown for April, which is over 46 per cent greater than that of April of a year ago. The decided improvement in these exports is shown by the total for the first 10 months of the present fiscal year which is given as $21,899,197, or over 34 per cent in excess of the total for the corresponding 10 months of the preceding fiscal year. The classified figures and total for last April are given below, together with the corresponding total of a year ago.

Article	No.	Value
Dynamos or generators		$ 187,098
Motors		403,093
Fans	3,492	28,517
Arc lamps	1,455	25,059
Carbon-filament lamps	187,566	23,799
Metal-filament lamps	129,215	34,284
Telegraph instruments (including wireless)		16,484
Telephones		106,848
All other		1,720,949
Total, April, 1913		$2,551,131
Total, April, 1912		1,744,016

Empire State Meeting.

The midyear meeting of the Empire State Gas and Electric Association was held in Ithaca, N. Y., on May 23 and 24. Papers were presented by C. A. Graves of the Southern New York Power Company on "Special Problems of the Small Electric Company," and by V. A. Miller, of the Canandaigua Gas Light Company, on "Problems of the Small Gas Company."

The Ithaca Automobile Club gave the delegates an automobile trip around the city and to the campus of Cornell University after the meeting.

The Seismograph.

At the meeting of the New York Electrical Society, held at the American Museum of Natural History, New York City, on May 30, a lecture on "The Seismograph and Its Revelations" was delivered by Harry Fielding Reid. This was followed by an interesting discussion of experiences with earthquakes. After the meeting there was a demonstration of the seismograph of the New York Academy of Sciences.

Louisville Rejuvenation Postponed.

The rejuvenation of the Jovian Order which was to have been held at Louisville, Ky., on June 4, has been postponed until September, owing to the fact that Statesman Carl Klemm was taken ill.

J. B. McCall.

In choosing Joseph B. McCall as president of the National Electric Light Association for the ensuing year, the convention last week maintained to this last official action its wisdom and keen appreciation of the bigness of its affairs. Well balanced, alert of mind, and the master of many problems over long years of experience in public-utility affairs, Mr. McCall is a fitting incumbent for the honor. And it is no easy matter to follow in office the strong men, who, down to and including Frank M. Tait, have guided the destiny of the Association.

For nearly twenty years Mr. McCall has been one of the conspicuous figures in the development of the electric light and power facilities of the City of Philadelphia and its suburbs. His interest in the electrical industry has always been practical and constructive and his ability has been demonstrated by the success he has achieved both as an organizer and as an executive. As president of the Philadelphia Electric Company from its inception, he has concentrated his energies upon the strengthening of this organization and the expansion of its field of operation, and largely as the result of his efforts, it has become one of the most important public utilities corporations in the country.

Joseph B. McCall,
President of the National Electric Light Association.

Joseph Benton McCall was born in New York City, May 12, 1870. In childhood he was taken by his parents to Philadelphia, and in the public schools of that city he received his education. His first employment was in the office of Rufus E. Shapley, of Philadelphia, with whom he took a position in 1885. During the year that he remained in this office he read law and took up the study of stenography. At the age of sixteen he started to work for the Pennsylvania Globe Gas Light Company and by the intelligent and efficient discharge of his duties gained successive promotions, being finally chosen secretary of the company. In 1895 he was one of the organizers of the Pennsylvania Heat, Light & Power Company, of which he became secretary and treasurer. In 1898 this company was absorbed by the Pennsylvania Manufacturing, Light & Power Company, and Mr. McCall was chosen president of the new organization; and when, during the following year, it was absorbed by the Philadelphia Electric Company, he was made president of the latter corporation, in which office he has since continued to serve. Since assuming the duties of the executive head of the company he has given practically his whole time to the furthering of its interests, to do which he has declined to become officially identified with outside enterprises. He has made an exception in the case of the First National Bank of Philadelphia, of which he has been a director for a number of years.

Mr. McCall served as president of the Association of Edison Illuminating Companies from 1904 to 1907, and as vice-president of the National Electric Light Association during the past year. He is an associate of the American Institute of Electrical Engineers and a member of the Franklin Institute of the State of Pennsylvania.

His clubs include the Country, Racquet, Merion Cricket and Associates of Philadelphia, and he is a member and vice-president of the Union League, of Philadelphia.

Mr. McCall was married September 30, 1889, to Lenore Adah Guest, and his family consists of two sons and one daughter.

He has always been a conspicuous figure at the National conventions and his election is deservedly popular.

Meeting of Eastern New York Section.

A meeting of the Eastern New York Section of the National Electric Light Association was held at Poughkeepsie, N. Y., on Wednesday, May 28. The subject of the meeting was "Rural Installations, Switching and Protection."

E. B. Merriam was the first speaker, and spoke particularly on getting current to rural installations, such as farming and dredging equipments, harvesting machines, etc. He showed a number of lantern slides of power substations of large and small capacity, high-tension lines, together with the arrangement or mounting the transformers and lightning arresters.

E. E. F. Creighton spoke on the subject of "Protection," showing by means of lantern slides the various types of lightning arresters, arcing-ground suppressors, and other devices particularly suitable for power substations for rural distribution.

Both papers were discussed by A. T. Throop, of the Utica Gas & Electric Company, Leon Scherck, of the Central Hudson Gas & Electric Company, H. W. Peck, of the Schenectady Illuminating Company, and others. About 75 members of the Section were present, and the meeting was quite a success.

At a meeting of the Executive Committee preceding the meeting of the Section, plans for a midsummer annual meeting were discussed and arrangements will probably be made for a meeting in the latter part of July or some time in August.

The annual meeting last year was held at Trenton Falls and was one of the most successful in the history of this geographical section.

Enormous Searchlight for Panama Exposition.

The Mount Tamalpais Railroad is planning to install the largest searchlight in the world on the top of Mount Tamalpais at the time of the Panama-Pacific Exposition in San Francisco. It is expected that the light from this source will illuminate the exposition grounds to an appreciable extent. A mirror and lens will be used in connection with the lamp, designed to concentrate the light upon a spot 100 feet square at a distance of nine miles.

American Electrical Manufacturers and the Tariff.

Manufacturers of electric supplies, says the *Wall Street Journal,* are not of the opinion that the proposed reduction in the tariff of 45 per cent on electric goods in general to 25 per cent will seriously affect their business. Records of exports and imports show quite clearly that American manufacturers of electrical goods have the jump on the world in this particular field of industrial activity. The history of the attempted invasions of this country reinforces that conclusion.

Following is the total of exports of electrical machinery and appliances, excluding bare iron and copper wire, for the last two years:

Exports for year ended December 31:

	1912	1911
Electrical machinery	$ 7,500,953	$ 8,347,524
Telegraph instruments (including wireless).	177,304	*28,854
Telephones	1,164,834	*441,619
All other	14,369,722	10,537,539
Total	23,212,813	19,355,536

Imports for six months ended December 31, 1912:

Electric lamps * arc, $18,342; incandescent—carbon filament, $70,064; metal filament, $180,541; total * $270,947.

The foregoing shows that our electrical exports are of first magnitude and increasing rapidly. For the ten months ended April 30 last, exports totaled $21,899,197 as against $16,317,914 for the same period a year previous, an increase of more than 34 per cent.

Imports of sufficient importance to be classified by the United States Bureau of Foreign and Domestic Commerce are at the rate of only about $500,000 per annum, which is negligible in comparison with this country's total production of electrical goods last year of $350,000,000.

The fate of those foreigners who have attempted to invade the electrical field here is sufficient proof that the smallness of imports is not due to a sheltering tariff wall.

The Siemens & Halske corporation of Germany, fourth in the list of the world's great electric manufacturing companies, and which turns out not only large power equipments, motors, incandescent lamps, etc., but also manufactures telephone apparatus, started a factory in the Central West some years ago, but abandoned it after operating several years at a loss.

Another large and successful telephone manufacturer from abroad opened a factory in the United States but its activities were never large nor its career prosperous.

Counter invasions of foreign countries by Americans have met with better success, although our foreign ventures have never grown so large or proved as prosperous as the home enterprises. The General Electric Company has a plant in England and for years has enjoyed a large and growing export business. The Western Electric Company has also built up a large export business in its lines. The development of that company's foreign business, has, however, been peculiar. The Western Electric Company is principally a manufacturer of telephone apparatus, and since in Europe and many other foreign countries, the governments operate the telephone service, they have been the chief if not the only customers for telephone apparatus.

On account of the policy of most foreign governments of purchasing only from home manufacturers, it has been necessary for the Western Electric Company to build many factories abroad. It has plants in England, Germany, France, Belgium, Austria, Hungary, Russia, Italy, Japan and Canada.

The Westinghouse Electric & Manufacturing Company has plants at Manchester, England; Havre, France; Ligure, Italy; Vienna, Austria; St. Petersburg, Russia, and at Hamilton, Canada. The company's foreign business suffered from the same causes that exerted an unfavorable influence on its affairs here, namely, over-expansion, but since its reorganization, the foreign investments are getting into better shape. The St. Petersburg plant, however, is in process of liquidation.

This country leads in electric manufacturing because we have never lost our position as pioneers in electric invention and development and also because the high degree of efficiency of American labor is second to none in the world.

*Not stated separately before July 1 last, hence figures cover six months ended December 31 last. No other items of export are stated separately.

Electric Club Meeting.

The history and development of the Chicago Plan Commission and the work which it is doing was interestingly outlined by J. F. Taylor before the Electric Club of Chicago on May 29. Mr. Taylor's address dealt with the preliminary work which the Commission is engaged in, and its plans for the immediate future. A great many lantern-slide illustrations were presented, showing graphically the conditions as they exist now in Chicago, how they compare with European cities and what the desired result will be.

Philadelphia Section Activities.

The annual meeting of the Philadelphia Electric Company Section, N. E. L. A., was held at the Franklin Institute on May 19. The chairman, B. Frank Day, presented his annual report and the reports of the various committees were presented in abstract.

The Membership Committee reported 209 new members.

The election of officers for the season of 1913-14 resulted as follows: chairman, Joseph B. Seaman; vice-chairman, William B. Ahern; secretary, Frank A. Birch. Executive Committee, B. Frank Day, H. P. Liversidge, J. T. Maxwell and Fred Zoller.

At the close of the Section meeting, Joseph D. Israel, general manager of the company Athletic Association, presented the cups and medals won by the successful contestants in the various Field Day events which were held May 10.

The Meter Department Branch held the last meeting of the season on May 2. A pleasant surprise was furnished by the presence of the new Peconela orchestra, which supplied music. The election of officers resulted in making Louis A. Schulze, chairman, and J. G. Johnson, secretary for the coming season. R. W. Pfaff and E. E. Robertson contributed to the program by telling "line experiences."

The May meeting of the Engineering Department Branch was held on May 5. "Certain Features of Substation Design and Operation" was presented by A. R. Cheyney, and "Certain Features of Alternating-Current Distribution" by D. Fred Schick.

Messrs. Adams, Penrose, A. L. Donnelly, Deshong, Liversidge and G. R. Green took part in the discussion.

On May 21 the Engineering Department Branch held a shad dinner at Tacony. The first feature was a boat ride up the Delaware River to Tacony with 125 members on board.

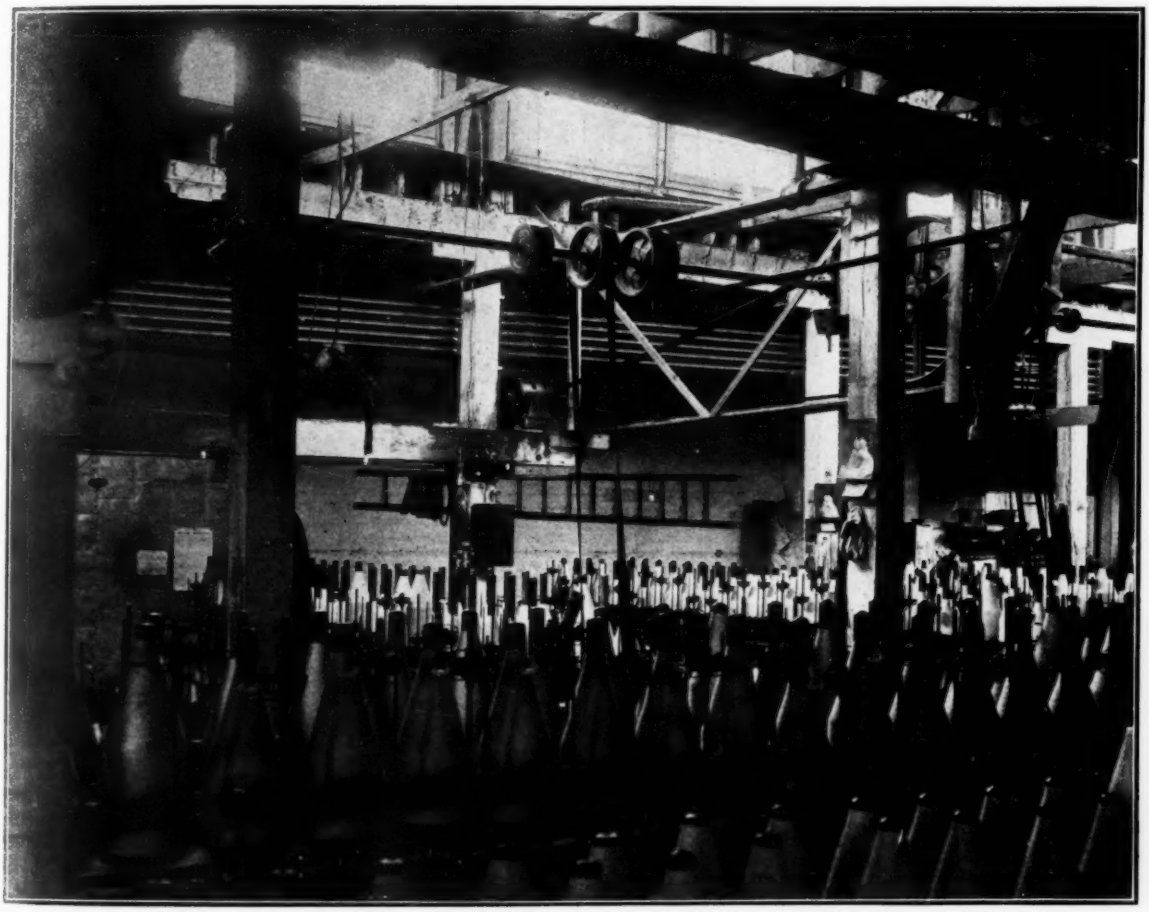
The Accounting Department Branch held its regular meeting on May 13. This meeting combined entertainment, sociability and business. The election of officers made John F. Ford, chairman, and Francis X. Jones, secretary for the season 1913-14. Cash prizes were awarded for the best papers presented during the year, the first to Joseph H. Nickel and second to R. A. Heubner. Prizes were also awarded to those members securing the highest rating in answering the "Efficiency Questions". T. M. Ford secured first prize, Byron B. Smith, second prize and the third prize was divided between S. G. Clark and J. J. Fay.

The May meeting of the Commercial Department Branch on May 26 was strictly a business meeting. The election resulted in George G. Finley as chairman, and E. J. Walsh as secretary. Yearly reports of the chairman and committees were read.

Electricity in Knitting Mills.

The advantages of electric motor drive that apply specifically to knitting mills, such as uniform drive, constant speed, reduced fire risk, improved lighting conditions, etc., are discussed in this article. There are also given operating data on a number of typical plants purchasing power.

The extension of the motor drive into all branches of the textile industry continues to demonstrate the advantages of this class of load to electric lighting and power companies interested in enlarging their long-hour-service earnings. The economic benefits of the electric drive by individual motors are much the same in all manufacturing establishments; but now and then the power engineer finds that the installation of electric motors is a peculiarly fortunate development, through the opportunities afforded to utilize the machine units in forced production and to suspend operations in one department or another without sustaining heavy losses in fuel or increasing the maintenance of the driving arrangements in undue relation to the volume of business. In the modern knitting mill these points are of especial interest.



Winding Frames in Mill of Blood Knitting Company, Amsterdam, N. Y.

In establishments of this kind the routing of material and the necessary light can be determining factors of location where machines are not rigidly located for convenience of mechanical drive. Corners which could not be used with mechanical drives become productive with individual motor or small group drives. These advantages result in more production and less wastage, conditions which are necessary for success in these days of curtailment and competition.

A reciprocating steam engine seems to give a steady speed when a speed indicator of the usual type is applied to its shaft. The rapid variations in angular velocity due to the change from linear to rotating motion, while too rapid to be seen, are usually great enough to cause wastage and to unduly shorten the useful life of knitting-mill machinery.

A long shaft driven by reciprocating engines often shows 10 per cent speed variation at the end farthest from the prime mover. This variation is caused by the initial unsteadiness of the prime mover, accentuated by the slipping and crowning of belts partly due to glazed spots and by the jerks of the machines themselves.

The steadiness of electric drive with their constant angular velocity, increases the useful life of the driven machinery and greatly reduces wastage. One mill which produces 60 miles of woven goods per hour, largely by electric drives, has found this reduction in wastage to be 10 per cent.

The slipping of belts between engine and driven machine frequently result in 10 to 20 per cent loss of speed in the latter. With group electric drive the number of belts and shafts is greatly reduced, while with individual-motor drive

they are entirely eliminated and each machine is kept up to its maximum productive speed at all times.

Mill machinery may be driven with individual motors, or in groups largely selected with reference to overtime operation. Only the machines actually wanted need be operated overtime. No long line shafts with their attendant power loss need be operated. No oilers need be paid overtime to watch bearings.

The foregoing are now commonly accepted as facts by mill owners but there is another advantage of motor drive that is less frequently thought of although the savings effected are equally as great—reduced fire risk. Where power is obtained from an adjacent steam plant the fire risk is great and insurance rates correspondingly high. The elimination of power plant and long lines of heavy shafting greatly reduces the danger of fire from overhead journal boxes or from spontaneous combustion of accumulated oily waste. Fire insurance companies recognize the reduced risk where central-station power is used and offer lower rates. Annual premiums have been reduced from 7 and 8 per cent to three-quarters and one per cent and the savings thus effected have, in many cases, gone far towards making up for the original cost of the electric installation.

Fewer bearings which can be arranged for easy inspection also tend to reduce the risk. Portable power indicators will tell at a glance if each machine is running freely in its bearings. Impending hot bearings are thus quickly and easily foretold before the fire risk becomes dangerous. The elimination of flapping belts reduces the dust flying around in the air and thus minimizes the risk of dust explosion. The ability to stop shafting promptly in case of an accident to an operative, where motors are employed, is by no means unimportant, while increased light and cleanliness due to elimination of overhead belts and bearings is of very great advantage.

Cycle of Operations.

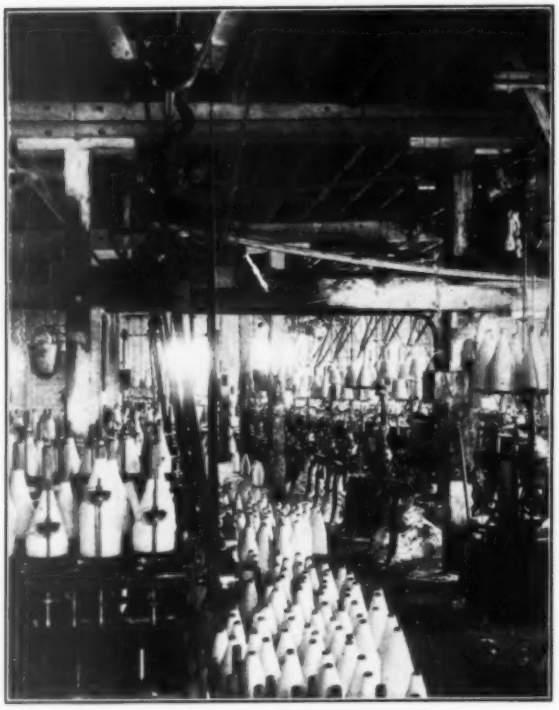
In general knitting mills may be divided into two classes: (1) mills spinning their own yarn; and (2) mills buying their yarn and confining their operations to knitting processes only. In an article on hosiery knitting mills, which appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for November 30, 1912, it was stated that a majority of the mills purchased their yarn. This condition does not seem to hold good for plants knitting underwear and other garments, as in practically every installation visited, spinning was either provided for or contemplated. A few of the very small plants, however, purchased their yarn. While this article will deal principally with the knitting operations involved in underwear making, a brief summary will be given of spinning operations. Complete data on this subject will be found in our issue of February 1, 1913.

The cycle of operations in the spinning department is, briefly, as follows. The raw cotton from the bales is drawn, usually by means of a suction conveyor, to the picker room. In the opener and breaker picker the cotton is beaten, the fibers loosened and the material converted from a dense matted mass into a light flaky one. During this operation, also, much of the sand and dirt is removed from the cotton. The fiber then passes to the intermediate and then to the finishing pickers, each of these machines again beating the cotton, cleaning it and finally passing it through perforated screens which compress the fibers and deliver it as a lap which is formed into a roll.

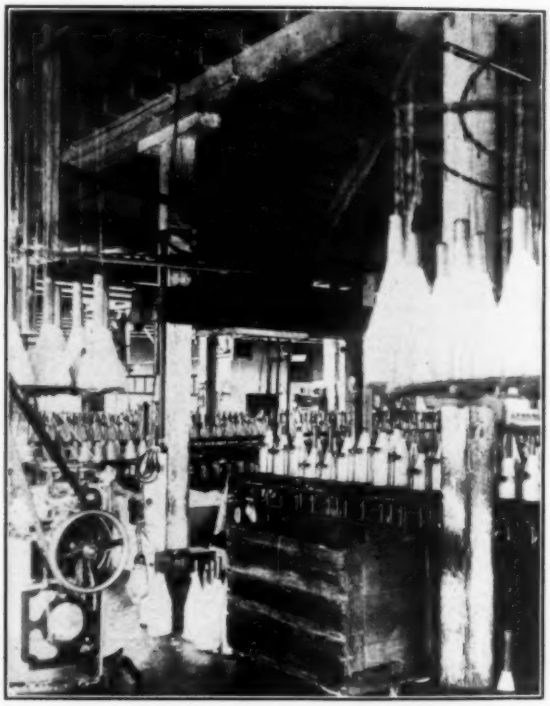
The carding room is the next department into which the cotton is taken. The rolls from the pickers are placed on the cards where the fibers are drawn approximately parallel by a combing process. The stock enters these machines as a sheet of lap and is converted into what is called sliver, a round string-like mass about one-half inch in diameter.

The use of combing machines depends entirely upon the grade of yarn being produced. When fine yarns are desired combing machines are used, the operation of these supplementing the work of the cards by sorting out the fibers to a uniform length.

Drawing is the next operation, the drawing frame receiving the sliver from either the combers or cards. This machine simply carries on to a greater degree the process of drawing fibers parallel. In this machine, however, several



Motor Driving Group of Knitting Machines.



Winding Frames Driven by 20-Horsepower Motor.

Knitting Mill Data Sheet No. 1.

The term load-factor is used in these data in such a sense that a load-factor of 100 per cent represents the use for 24 hours every day of power corresponding to the rated capacity of the motors connected. An operating-time load-factor of 100 per cent represents the use of the rated capacity of the motors for the running hours per day specified for each installation.

Plant located in Amsterdam, N. Y., manufacturing men's knitted underwear. The average output of the mill is 1,300 dozen garments per day.

Total connected horsepower, 130. Total number of motors installed, 15. Average kilowatt-hours per month, 34,936.

Kilowatt-hour consumption for 12 months:

Month	Kilowatt-hours	Month	Kilowatt-hours	Month	Kilowatt-hours
January	28,596	May	38,447	September	35,100
February	34,828	June	36,100	October	41,210
March	30,406	July	33,550	November	35,000
April	38,778	August	31,770	December	35,450

Load-factor, 50 per cent.

Motor Installation.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts.

No.	Horse-power.	Speed R. P. M.	Application.
4	5	1,140	Each belted to a table driving 36 sewing machines of various makes.
4	7.5	1,200	Each belted to a table driving 36 Union Special seamers and seam coverers.
1	25	1,200	Belted to a line shaft driving three Gessener nappers.
1	15	1,200	Belted to a line shaft driving 13 Wildman lash-needle knitting machines of 18 and 12-inch diameters.
1	20	1,200	Belted to a line shaft driving 34 Wildman lash-needle knitting machines of 14 and 20-inch diameters.
1	10	1,200	Belted to a line shaft driving 11 Wildman lash-needle knitting machines of 19 and 22-inch diameters.
1	2.5	1,200	Belted to line shafting driving five 48-end winders.
1	2.5	1,200	Belted to a line shaft driving 10 40-end winders.
1	5	1,200	Belted to a line shaft driving 10 Cooper rib machines.

This plant is at present purchasing yarn, but arrangements are being made to install spinning equipment.

Knitting mill manufacturing a general line of knit goods. Twenty persons are employed. The average output is 60 dozen garments per day.

Total connected horsepower, 25. Total number of motors installed, 2. Average kilowatt-hours per month, 204.

Kilowatt-hour consumption for 12 months:

Month	Kilowatt-hours	Month	Kilowatt-hours	Month	Kilowatt-hours
January	182	May	131	September	120
February	208	June	90	October	138
March	134	July	128	November	166
April	275	August	128	December	754

Load-factor, 1.5 per cent.

The electrical energy consumption per 1,000 garments manufactured is 10 kilowatt-hours.

Motor Installation.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts. Squirrel-cage induction motors are used.

No.	Horse-power.	Speed R. P. M.	Application.
1	20	1,680	Belted to 70 feet of line shafting, 17 hangers, driving one 5-kilowatt 110-volt generator; one G. W. Payne 48-spindle winder; one cloth turner; 11 Scott & Williams circular interlock knitting machines of the following diameters: one 17-inch, one 16-inch, two 15-inch, one 14-inch, one 13-inch, one 12-inch, one 11-inch, one 10-inch and one 8-inch.
1	5	1,700	Belted to a 45-foot line shaft, seven hangers, driving one Singer seamer; two Metropolitan seamers; one Merrow edger; one Union special cover seamer; two Metropolitan staying machines; one Singer finisher; one Merrow shell; one Wheeler & Wilson tucker; one small emery wheel, and one small buffing wheel.

Plant knitting men's union suits.

One 10-horsepower squirrel-cage motor is installed. Average kilowatt-hours per month, 534.

Kilowatt-hour consumption for 8 months:

Month	Kilowatt-hours	Month	Kilowatt-hours	Month	Kilowatt-hours
May	234	August	776	November	725
June	288	September	394	December	1,044
July	353	October	465		

Load-factor, 9.8 per cent.

Motor Installation.

No.	Horse-power.	Speed R. P. M.	Application.
1	10	1,120	Belted to shafting driving six Scott & Williams knitting machines; two winders, and 20 sewing machines.

Knitting Mill Data—Sheet No. 2.

Knitting mill located in Utica, N. Y., manufacturing knit underwear of various grades and colors. The average production is 1,000 dozen garments per day. A night shift is employed.

Total connected horsepower, 183. Total number of motors installed, 9. Average kilowatt-hours per month, 32,400.

Kilowatt-hour consumption for 12 months:

Month	Kilowatt-hours	Month	Kilowatt-hours	Month	Kilowatt-hours
January	24,180	May	35,960	September	27,360
February	26,770	June	29,320	October	28,480
March	34,900	July	41,570	November	30,480
April	49,400	August	30,900	December	29,560

Load-factor, 32 per cent.

The electrical energy consumption per 1,000 garments manufactured is 106 kilowatt-hours.

Motor Installation.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts and 440 volts. All motors installed are of the squirrel-cage induction type.

No.	Horse-power.	Speed R. P. M.	Application.
1	10	1,120	Belted to line shafting (209 feet) driving seven George Payne skein winders, 48 skeins; seven Campbell Clute skein winders, 48 skeins; one George Payne skein winder, 40 wheels having six skein holders on each wheel; 29 Scott & Williams tubular knitting machines of the following diameters: one 23-inch, one 22-inch, one 21-inch, two 20-inch, four 19-inch, three 18-inch, three 17-inch, two 15-inch, three 14-inch, five 13-inch, three 12-inch, and one 11-inch; two small yarn-chaining machines; and two Snyder skein winders, 48 skeins.
1	20	1,120	Belted to line shafting (145 feet) driving three Tiffany double collarette knitting machines; five Cooper 23-inch tubular knitting machines; 14 Tompkins tubular knitting machines of the following cylinder diameters: one 21-inch, one 20-inch, two 19-inch, three 18-inch, two 17-inch, two 16-inch, one 15-inch, one 14-inch and one 12-inch; five winding reels; four Davis & Furber napping machines, 10-foot rolls; one Aland 36-inch exhaust fan; and one 0.25-kilowatt direct-current generator for operating cutter.
1	20	1,120	Belted to shafting driving 96 Scott & Williams tubular knitting machines of the following cylinder diameters: three 21-inch, 5 20-inch, 13 19-inch, nine 17-inch, 11 16-inch; four 15-inch, 10 14-inch, 10 13-inch, 11 12-inch, three 11-inch, and four 10-inch; one six-inch emery wheel; one Campbell Clute skein winder; one knit-garment reel; and one Fisher 20th Century knitting machine.
1	20	1,120	Belted to shafting driving three Merrow machines; 22 seamers; 16 Dewees trimmers; two lace machines; two neck markers; 10 Singer button-hole stitchers; eight button sewers; five tackers; seven button-staying machines; three tuckers; and 41 miscellaneous sewing machines.
1	20	1,120	Belted to line shaft driving three collarette machines; 22 finishers; two double-seating machines; one binder; one finisher; four button-hole stitchers; two button sewers; one strapper; two hangers; two trimmers; 14 Merrow machines; nine cuff sewers; one eyelet machine; two rib cutters; four cover seamers; and 35 Union Special seamers.
1	20	1,120	Belted to shafting driving three washing and bleaching machines; one duplex plunger pump; and one four-inch centrifugal pump.
1	20	1,120	Belted to shafting driving four seven-foot dye tubs; one three-foot dye tub; and three 40-inch extractors.
1	50	850	Belted to an American No. 90 steel-plate fan.
1	3	1,120	Belted to shafting driving machine-shop equipment.

Knitting mill manufacturing a high grade of men's union suits. Average output 100 dozen garments per day. Thirty-five people are employed.

Total connected horsepower, 15. Number of motors, 2. Average kilowatt-hours per month, 1,493.

Kilowatt-hour consumption for 11 months:

Month	Kilowatt-hours	Month	Kilowatt-hours	Month	Kilowatt-hours
December	1,722	April	1,886	August	1,091
January	1,663	May	1,304	September	1,609
February	1,659	June	1,569	October	1,358
March	1,301	July	1,263		

Load-factor, 18 per cent.

The electrical energy consumption per 1,000 garments manufactured is 50 kilowatt-hours.

Motor Installation.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts. Motors are of the squirrel-cage induction tpye.

No.	Horse-power.	Speed R. P. M.	Application.
1	10	1,120	Belted to a 32-foot shaft, six hangers, and two countershafts driving 16 Stafford & Holt circular knitting machines, varying in size from 13 to 22 inches in diameter; one George W. Payne 48-spindle winder; and one small double emery wheel.
1	5	1,120	Belted to two 32-foot shafts, 442 revolutions per minute, driving 28 small machines (sewing machines, sitchers, seamers, etc.) made by Singer, Metropolitan and Union Companies.

ends of sliver are fed between sets of drawing rolls and are drawn out into a single sliver approximately equal in dimensions to the sliver fed into the machines.

The first twist given the yarn is on the slubbers. Sliver from the drawing frames passes to the slubbers, which are equipped with drawing rolls and spindles, upon which bobbins are revolved, winding the drawn and slightly twisted stock. The slubbing, which is the name of the stock as it leaves these machines, is then taken to the roving frames, where it is further drawn out, twisted and wound on bobbins. The yarn then usually passes to intermediate frames and fine frames, these machines simply supplementing the drawing and twisting processes previously given the yarn.

Sewing Machines Driven by Motor.

The final preparatory process is spinning. On the spinning frames the yarn is still further drawn out and given its final twist. Spinning is either accomplished by mule or ring frames. From the spinning room the yarn is taken to the knitting machines.

Motor Applications.

In the spinning departments motor applications have become standardized and the conditions to be met do not differ materially from those found in the average cotton mill. Pickers should be located in a room surrounded with fire walls having self-closing steel doors and fitted with fire hose and automatic sprinkler system. Relative to the machines, the opener with its auto-apron feed and three-bladed beater running at 1,000 revolutions per minute, the breaker pickers with their two-bladed beaters running at 1,100 revolutions per minute, the intermediates with their two-bladed steel beaters and the finisher pickers with their three-bladed pin beaters are all best driven by individual motors suspended from the ceiling. The motors are thus out of danger from broom handles in the hands of careless operatives. All the benefits due to sub-division of power, localizing shut downs and eliminating line-shaft friction are realized with this drive.

Belt maintenance is a considerable item with this drive and maximum production is just out of reach due to belt slippage. Motor starting boxes should be placed on side walls nearby. Some pickers are driven by motors placed under the apron and some by motors placed on "A" bracket attached above the picker frame. These drives are open to objections mentioned and the motors are liable to be damaged by carelessness on the part of operatives.

The direct-connected individual-motor picker drive, with rotating part of motor on extension of beater shaft gives maximum production, since all slipping is eliminated and it does away with the cost of belt maintenance. In this drive the motor frame is attached by a bracket to picker frame and the rotating part has no bearings other than those of the beater shaft.

Cards, combs, sliver and ribbon-lap machines are either shut down for grinding or cleaning part of the time or take very little power, and their drive is smooth and jerkless. Here group drive has proven most economical, since the motor need only be large enough to handle machines actually running at one time. If individual motors were used, each would have to be large enough to run its machine and the total power of all motors would be greatly in excess of the power required for a group driving.

The individual drive would also be expensive as compared to the group drive since cost per horsepower of motor is less in large sizes.

The four-frame drive is unquestionably one of the cheapest and it is believed by many to be the best for slubbers, intermediate, fly and spinning frames. This drive as applied to spinning frames consists usually of a ceiling-suspended motor with four pulleys on its shafts which drive four spinning frames below by means of belts. Every machine has its tight and loose pulleys and it is operated as the operator has been in the habit of doing. Push buttons for shutting down the motor can be located where desired.

Four-frame-drive motors should have extra heavy shafts and long bearings, the former to prevent the shaft from bending and the latter to make bearings last long. All bearings should have two oil rings, large oil wells and sight-feed oil gauges placed in full view. Motors should have tapped holes on either side for oil gauges and those not desired can be plugged. At the present time one will see the old group system with long line shafts frequently used for drawing and mule spinning, but new mills will follow the latest practice.

Fly frames and ring-spinning frames are frequently driven by a direct-connected motor with satisfaction, but some connection should be provided which will admit of changing the speed should a different length of staple be used.

Bending or improper humidity may make a frame require twice its ordinary driving power to start it. For this reason starting a number of motors at the same time is not always advisable. Individual compensators are sometimes used for starting, but a cheaper way is to use one compensator to start all motors in a room, the connection being arranged so that only those loads can be started at one time which cannot overtax the motor.

Unless a piece of fabric is run or pricked on to the needles, as is the case in the running on of a top or end of glove, the flat machine must always be set up on a plain rib, even though tuck rib or circular plain work is desired. For this purpose a set-up comb is provided and the first operation is to make a half round and then push the wires of the set-up comb through the loops, threaded in the wire and attach the weight. Next put on take-up spring and set the cams for desired class of work.

There are three common methods of applying the electric motors to knitting machines, the choice of which must be largely determined by local conditions. In some cases each room or division of the factory may be driven by a single motor retaining the old shafts and belts. This offers an easy solution to the prob-

lem of converting an old mill to electric drive. Since each floor or department is, by this means, operated as a unit, production may be regulated to good advantage.

The second method is to sub-divide the floors into groups driven by motors of from one to ten horsepower depending on the size of the cylinders and the number of machines in each section. These divisions are very natural ones as a rule since for underwear sleevers from 10 to 50 machines are usually connected by light belts to a common shaft mounted on the floor or ceiling and for heavy underwear machines with cylinder from 12 to 28 inches two or more are mounted on a table with a common shaft. It is a simple matter to connect the motor directly to this shaft; gears. chains or belts are used to transmit the power, the choice between the three being a matter of individual preference as each has certain advantages. In using steel or cast-iron gears it is well to use a pitch-line speed less than 1,100 feet per minute on account of the vibration and noise attendant on high-speed operation.

The third method is to place a motor of fractional horsepower on each machine. In reality this is the ideal method, as each machine is independent of every other, and all the advantages of the small group are further accentuated. As in other industries, individual drive is the latest development and productive of the best results.

Any of the three methods discussed is of course applicable to the drive of ribbers or circular knitting machines if the motor be properly selected for the work to be done.

One of the chief troubles experienced with knit goods consists of small holes or "birds-eyes" which are generally attributed to the derangement of the setting of the dial, tucking or other cam. After the cams have been properly adjusted they may be displaced by jarring or jerking of the machine, which will cause the work to run badly. A slipping belt is a splendid means for throwing the cams out of adjustment.

The breakage of needles is dependent to a certain degree upon the condition and quality of the yarn, but a regular speed will undoubtedly increase the chances of the needle to care for uneven yarns whether using spring or latch needles. In one small mill a saving of $2.00 a day has been realized in the breakage of needles alone since the installation of motor drive, using exactly the same kind of yarn as before. While a small item, yet the care of needles is one of the details that go to make profits for the business.

Some hosiery manufacturers claim that, due to the more regular speed of the individually driven frames, they may be speeded up several courses faster than if belt driven. This is very desirable if it can be done without detriment to the work, as the increase production is a direct increase on the profits of the business. All these motors may be equipped with oil switches so that they may be started and stopped from the shipper handle. Thus the knitter is not required to perform any new operations.

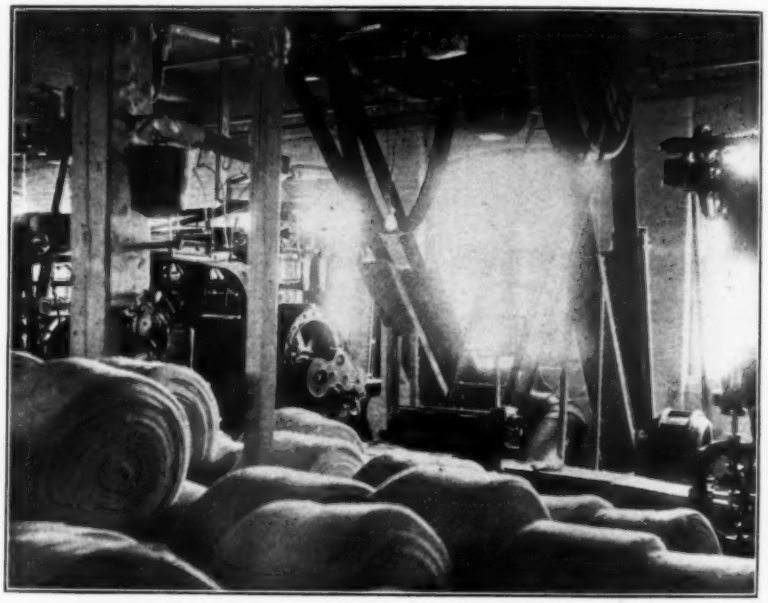
Winders, knitting machines, pipe turning machines and nappers. These machines require such a small amount of power and are so steady in their power requirements that every class can be satisfactorily group driven. Usually at the end of a row of knitting machines there is located a latch-knitting machine. An installation that may be considered typical of this practice is in a large western knitting mill where a 20-horsepower motor drives 81 knitting machines, 11 to 23 inch capacity; 10-horsepower motor drives 37 extra large Scott & Williams knitting machines, including a 26-inch latch knitting machine, and a 15-horse-power motor drives 21, 40-spindle winders and an elevator. These machines when their needles are frequently oiled run for years without any appreciable power trouble.

Dye Houses. Many of the small knitting mills, and in fact some of considerable size, do not handle their own dyeing and finishing, but send their entire production to outside dye houses, or else use colored stock. The process of raw-stock dyeing has been improved in many ways and for manufacturing certain grades of material, yarn colored either in skein or in the raw stock can be used successfully for manufacturing the majority of goods.

Group drive usually is employed in dye houses. Some of the machines being shut down a large part of the time and many of them require only a small amount of power, group drive is the cheapest here since motor capacity need not equal the total power requirements of the room or department. While alternating-current constant-speed motors are frequently used, variable-speed motors can be used where dyeing is done at varying speeds.

Cutting Machines. These machines are often driven by individual motors with great satisfaction, but the Weyburn type is well suited to 12-group drives from a two-horsepower motor.

Sewing Machines, Winders, Presses, Etc. All the auxiliary machines in the knitting mill may be as readily driven with motors as the knitting machines themselves. An attractive drive for sewing machines is to have a motor for each table, carrying from 5 to 40 machines belted to a common shaft. The methods of mounting the motor are various.



Napping Machines Driven by 25-Horsepower Motor.

White Way for Yonkers.

Contracts have been closed with the Yonkers (N. Y.) Electric Light & Power Company and all arrangements made for the erection and connection of 150 ornamental iron lampposts for street lighting in the City of Yonkers. When the new posts are installed the city beyond Spuyten Duyvil will have a lighting system as elaborate and effective as any community of its size in the country, according to W. T. Morrison, manager of the Bronx and Yonkers districts.

Each post will be equipped with four 60-watt and one 100-watt tungsten lamps. The posts will be erected on each side of the streets radiating from Getty Square.

Commercial Practice
Management, Rates, New Business

Reduced Rates for Los Angeles.

On July 1 the residents of Los Angeles, Cal., are to be given a reduction in the electric rates now in force, this reduction to be from 6.5 cents to 6 cents for each kilowatt-hour. The minimum rate is 65 cents for 11 kilowatt-hours or less consumed in any one month.

Following is the new schedule:

For the first 100 kilowatt-hours consumed in one month, 6 cents per kilowatt-hour.
For the next 150 kilowatt-hours consumed in one month, 5.75 cents per kilowatt-hour.
For the next 250 kilowatt-hours consumed in one month, 5.25 cents per kilowatt hour.
For the next 500 kilowatt-hours consumed in one month, 4.5 cents per kilowatt hour.
For the next 1,000 kilowatt-hours consumed in one month, 3.5 cents per kilowatt-hour.
For the next 1,000 kilowatt-hours consumed in one month, 2.6 cents per kilowatt-hour.
Over 3,000 kilowatt-hours consumed in one month, 2.3 cents per kilowatt-hour.

Power Schedule.

For the first 100 kilowatt-hours consumed in one month, 5 cents per kilowatt-hour.
For the next 200 kilowatt-hours consumed in one month, 4.5 cents per kilowatt-hour.
For the next 200 kilowatt-hours consumed in one month, 4 cents per kilowatt hour.
For the next 500 kilowatt-hours consumed in one month, 3 cents per kilowatt-hour.
For the next 500 kilowatt-hours consumed in one month, 2.5 cents per kilowatt-hour.
For the next 500 kilowatt-hours consumed in one month, 2 cents per kilowatt-hour.
For the next 1,000 kilowatt-hours consumed in one month, 1.8 cents per kilowatt-hour.
Over 3,000 kilowatt-hours consumed in one month, 1.2 cents per kilowatt-hour.

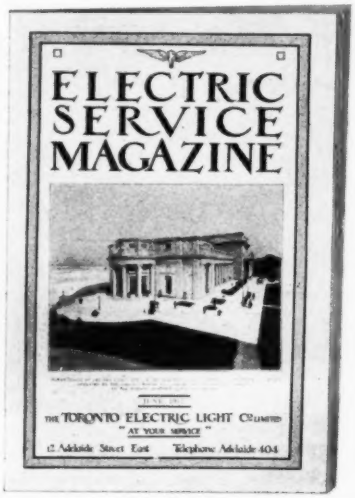
For furnishing electric current for power purposes under the foregoing schedule a charge of 35 cents per month per horsepower installed will be made, providing that the minimum charge shall not be less than $1.00 per month.

Serving Outlying Lumber Mills.

Central stations in the hardwood section of the Ohio Valley are giving particular attention at present to a new character of consumer who is steadily growing more important, the wholesale hardwood lumberman. The typical jobber does no manufacturing, merely rehandling the lumber drawn in from small mills in his territory. It has been found, however, that a profitable class of work can be developed in remanufacturing this lumber to the end of bettering the grade by eliminating defects, such as will improve the character of the lumber without too great loss of material. It was recently reported that a lumberman made $50 on a car of walnut by putting it through the saws. The equipment consists of a ripsaw and a cross-cut saw, belt-connected to a motor of about 10-horsepower capacity. While individual installations are not particularly important, the business in the aggregate is worth having, especially as the needs of a lumberman in this condition can be met only by the use of central-station service.

House Organ for Toronto Company.

To the rapidly growing list of central-station companies issuing house organs has now been added the Toronto Electric Light Company., Ltd., of Toronto, Canada, whose *Electric Service Magazine* has just made its appearance. In the words of the editor, the company launches this magazine "as a medium of closer, more direct and more intimate communication with the great and growing Toronto public and through it hopes to keep the public somewhat informed of the latest developments in the practical applications of electrical science."



Cover Design of Toronto Company's New House Organ.

If the initial number may be considered as a sample of those that are to follow, the success of the publication is assured. It is replete with interesting and instructive matter pertaining to the supply of electric service and in physical appearance, as well as editorially, bears the imprint of an experienced hand. The accompanying illustration is a reproduction of the cover design of the current issue.

Progress in a Small Central Station.

A city in Ohio of 12,000 people maintained a lighting plant which was considered to be as progressive and modern as the average central station; however, about a year ago this company was purchased by some men who seemed to know more about central-station work than the average central-station man and in one year have increased the load 50 per cent, or in other words, the new management has added to its lines half as much as it took 20 years under the old methods and management to acquire.

This ought to be very interesting to any live central-station man. There seemed to be two prevailing ideas existing in the minds of this new business-getting department.

First, there was no sound economic reason why anyone using electric lights or power within a radius of five miles should not buy from them. Second, that no new house built within the reach of their lines should be erected without being wired. They seem to base their beliefs upon purely economic reasons and they stand ready at all times to justify their beliefs. Armed with the faith which they have in these principles, they were able to land a large amount of business which they otherwise never would have attempted if they had not had this firm belief that they were the largest manufacturers of current in that section, and that they should be able to sell to anyone using less than they made.

The new-business department consisted of a manager and three solicitors. The town was divided into six sections; the business district comprised three sections and the residence section three sections; the purpose of this being to give each solicitor one residence and one business district, in order to make comparable the work of each solicitor, so far as the results were concerned.

A house-to-house canvass was made and a record taken of every building in the city, this record being made upon cards which were divided into different classes representing live prospects, possible prospects, etc., down to those upon which it seemed useless to waste any time.

In order to take care of the combined efforts of each man, the first ten days

in the month were devoted to advertising and soliciting the sale of appliances in the residence districts. From the 10th to the 20th of the month advertising and soliciting for house wiring was specialized upon. From the 20th to the 30th advertising and sign work.

In the mind of the management this united effort seemed to work out better than miscellaneous solicitation. As an example the manager stated that before they took over the plant, only three toasters were sold, while during the first ten days of the month upon which they concentrated their efforts, 30 toasters were sold. They stated that they put out irons upon 30 days' trial, and a careful record showed that 90 per cent of those put out were sold.

Their records show that 80 per cent of the houses being put up in the city are being wired, and that while a year ago there were no electric signs, they now have close to 50, with an income of over $300 per month from the signs alone. This company also has a contract which they call their flat-rate contract for window lighting and sign work. After a careful record they claim that this circuit net them 6.66 cents per kilowatt-hour.

No one visiting this station can help but realize that they are live, energetic men pushing the selling of current, and the housewife as well as the business man realizes the advantages to be derived from the use of electric equipment. The manager stated that he was convinced that it was a good policy for the central stations to sell appliances, but that he believed it was poor merchandising to sell them for less than the regular prices asked by other dealers; as he was awake to the fact that the co-operation of all electrical dealers was a big asset.

This company also co-operates with the contractors and is glad to turn over gratis to the contractor, any business which comes to it for house wiring, giving the preference to any contractor whom the builder seemed to favor.

Electric Pumping in Stockton, California.

Owing to the water level being so near the surface, in San Joaquin County, California (in which Stockton is located), it has been found very cheap to raise the water and use it for irrigation by means of electrically operated pumps. As a result of this more than 300 pumping plants driven by electric motors have been installed in the adjacent territory. All of this business has been secured by the Western States Gas & Electric Company. Since the first of the year this company has gained 2,249 horsepower in power business.

Introducing Central-Station Power at the Quarries of Bedford, Ind.

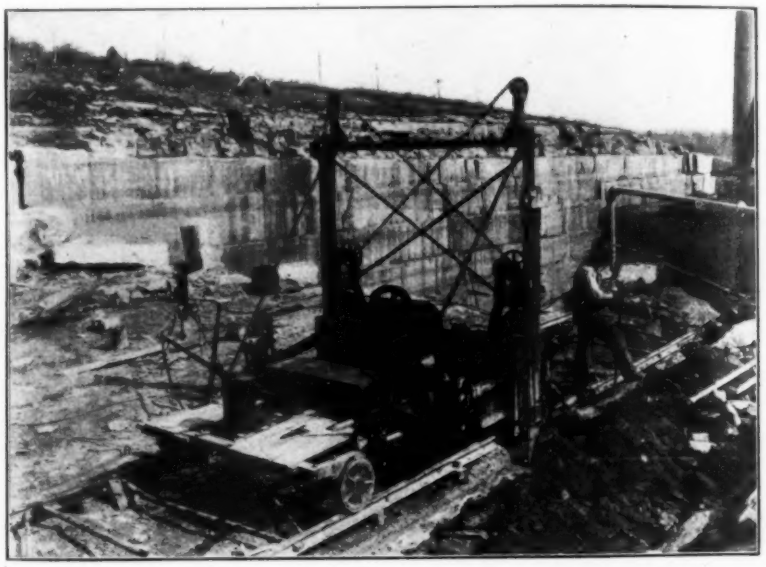
A very successful campaign for additional day load has been carried on for the past two years by the Southern Indiana Power Company, Bedford, Ind., which resulted in adding approximately 5,500 horsepower to the load.

The town of Bedford is surrounded by a large number of quarries where the well-known Bedford stone, a kind of limestone, is quarried in large quantities for building purposes. Until the central station began its campaign, practically all of the quarries and the mills for finishing the stone, were operated either directly from steam engines or by isolated electric plants.

The quarries were the first to be attacked. The main application here consisted of channelers which cut out the stone. These channelers move along tracks, which rest on top of the stone to be quarried, and cut deep grooves on either side. When steam driven, they must carry coal around with them; they must be supplied, with considerable difficulty, with satisfactory water, and they require the services of two men, one to operate the channeler and the other to fire the boiler and take care of the engine. Since motor drive eliminated the coal and water problem and rendered the services of one man unnecessary, the change-over was accomplished without much difficulty after the power campaign was in systematic operation. Slip-ring induction motors, which permit operation at various speeds, are used for driving the channelers.

After having disposed of the quarries, the central station next directed its efforts against the mills where the stone is dressed. These mills are mostly located in the town of Bedford, the stone being hauled from the quarries by rail.

The executives of the central station made a personal canvass of the mills and succeeded in interesting the majority in central-station power. In places where isolated plants were abandoned, alternating-current motors were substituted as far as possible for the original direct-current machines. In some cases, however, direct current was preferable, especially for operating the cranes in certain mills. These cranes developed very heavy peak loads and in order to take care of them, small motor-generator sets, having slip-ring alternating-current motors and heavy flywheels were installed; these sets permit the flywheel to carry the peak, thus reducing the fluctuations in the demand for power.



Electric Channelers in Stone Quarry.

At the present time, 80 per cent of all Bedford quarries and stone mills are being served with the Southern Indiana Power Company's power.

Zinc Mine Buys Power.

The Interstate Light & Power Company, a Byllesby concern, located at Galena, Ill., recently closed a contract covering 310 horsepower in motors with the Mineral Point Zinc Company for the Black Jack Mine, located a short distance south of the city. Preparations are under way for serving the mine. The great majority of the power needs of the zinc and lead mines in this territory are served by the Interstate Company. Mining activities which were temporarily affected by the tariff measures are resuming normal conditions and several new mines are being opened up.

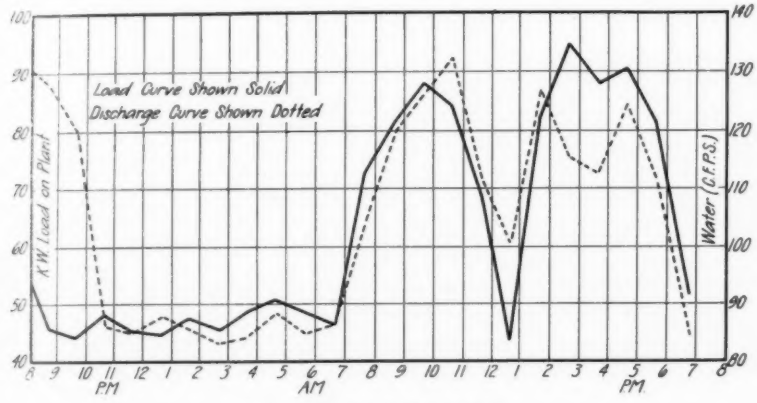
Efficiency of a Small Hydroelectric Plant.

The following data were taken from the report of a test of a small hydroelectric plant furnishing power for the lighting and motor load of several shops at a rolling mill. The plant is situated on a river about 300 feet from the mill and includes two 33-inch special McCormick horizintal turbines running at 160 revolution per minute, rated at appromimately 117 horsepower under a head of 13 feet, and a 150-kilowatt, 250-volt, compound-wound direct-current generator driven at 600 revolutions per minute. The turbines are set in an open pit with a shaft extending into the power station connected to the generator by an American rope drive. The speed regulation is under control of a belt-driven Lombard governor. The tail race is about 11 feet deep under the turbines, and slopes upward to a depth of three feet at an angle of 45 degrees, measurements being made from the surface of the water under normal conditions. The available head is about 12.5 feet. There is a heavy arc-light load at night, as the mill is in operation 24 hours a day.

A 24-hour test was made, showing the load curve for an average day's run. The quantity of water discharged from the turbines was measured by the velocity-area method, and the velocity of flow was determined by the use of a Fteley current meter, the readings being made by the integration method. The head of water was measured by means of fixed rod gages secured to the sides of the head and tail races. Velocity measurements were made in the tail race at a station about 45 feet from the dam. The output of the generator was measured by means of a portable voltmeter and ammeter, and the speed determined by a magneto and a voltmeter. The voltmeter was connected to the same terminals as the station voltmeter, and a mill-voltmeter with its shunt in the line inside that of the station ammeter was used to obtain the current. The magneto was belted to the end of the generator shaft.

The mode of operation in the test was as follows: Two men were assigned to the current meter, a third man read the electrical instruments and the gages in the head and tail races, readings being made every 20 minutes. The loss of power in the rope drive which was practically constant, as the speed did not vary, and the power used by the governor were not determined but charged against the turbine.

The main results of the test are shown in the following table:



Load Curve for 24-Hour Run.

Water used by the turbines (c.f.p.s.)	101
Head on turbines	14.06 feet
Input to turbines	161 horsepower
Input to generator	72.4 kilowatts
Output of turbines	97 horsepower
Output of generator	62.9 kilowatts
Speed of generator	607 revolutions per min.
Efficiency of generator	87 per cent
Efficiency of turbine	60.1 per cent

The load curve can hardly be taken as an average load curve since the peaks depend on heavy work which might occur at different times on other days. Reference to the load and discharge curves shows that a considerable part of the run is comprised of low loads, resulting in a lower average efficiency than would have been obtained by a constant load of the same average value observed during the test. Computations based on an average of two readings taken from the 24-hour run under fairly constant conditions gave a turbine efficiency of 78.5 per cent, comparing favorably with the results obtained in the manufacturer's tests.

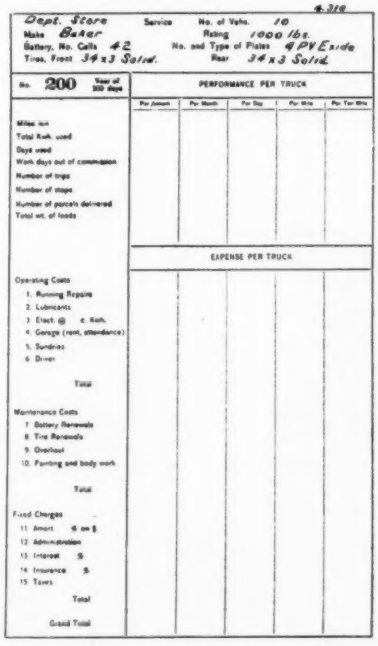
Springfied Rates Reduced.

The United Electric Light Company of Springfield, Mass., has announced a reduction in the maximum lighting rate to 9 cents per kilowatt-hour, effective July 1.

System for Compiling Vehicle Data.

In order to be able to talk intelligently to customers relative to the service that can be expected from an electric vehicle and also in order to make comparisons between the maintenance costs of electric with other vehicles, it is necessary to have accurate data, preferably from actual installations.

The Automobile Bureau of the New York Edison Company, maintains a file of electric-vehicle cost and operating data for the use and guidance of prospective users, and a very elaborate system is maintained to keep this data as accurate as possible. Forms, one of which is reproduced herewith, are used, which provide for keeping yearly, monthly and daily records as well as figures per mile and per ton-mile. Similar sheets on a larger scale are sent to vehicle users, and after a suitable interval the data recorded upon them are transferred to the office file.



Data Card Used by New York Edison Company.

Central-Station Service for Steam-Engine Plant.

The Minneapolis General Electric Company recently closed a contract with the Minneapolis Steel & Machinery Company covering 1,066 horsepower at present and ultimately 1,500 horsepower. A period of ten years is specified in the contract. The machinery concern has been operating its private plant for 20 years. One of its products is steam engines.

Electrical Construction

COMMON-SENSE METHODS OF MAKING WIRING CALCULATIONS.

By N. V. Dunne.

1. For calculating direct-current, two-wire circuits the following formula is used:

$$A = 22 \times I \times L \div E;$$

where E is the drop in volts in the circuit, I the current in amperes in the circuit, L the length one way or single distance of the circuit in feet, and A the cross-section of the conductor in circular mils. Other forms of the formula are:

$$E = 22 \times I \times L \div A;$$

$$I = A \times E \div (22 \times L); \quad L = A \times E \div (22 \times I).$$

Example. What size wire should be used for the branch circuit of Fig. 1? Allowable drop to the remotest lamp is 1 volt. Load consists of 10 incandescent lamps each taking 0.5 ampere. Distance from starting point of circuit to load center is 45 feet.

Solution. Substituting in the formula, we have,

$$A = 22\,I\,L \div E = 22 \times 5 \times 45 = 4950 \text{ circular mils.}$$

Referring to the table of carrying capacities from the National Electrical Code (Table 1), the standard size of wire next larger than 4950 circular mils is seen to be No. 12, which has an area of 6,530 circular mils. No. 12 wire, rubber insulated (for concealed work) safely carries, as given in the table, 17 amperes; hence it will readily carry the 5 amperes of the circuit in question.

Example. What size of wire should be used for the 220-volt motor main of Fig. 2? The total load is 114 + 40, or 154 amperes. Allowable drop is 5 per cent, or 11 volts to the last motor. Distance to load center is 120 feet.

Solution. Substitute in the formula thus:

$$A = 22\,I\,L \div E = 22 \times 154 \times 120 \div 11 = 36{,}960 \text{ circular mils.}$$

Referring to table of carrying capacities, No. 4 wire, which has a cross-section of 52,630 circular mils, is found to be the next largest standard size wire; it would keep the drop within the 11 volts allowed. But a No. 4 wire rubber-covered wire has a safe carrying capacity of but 65 amperes. The circuit under consideration carries 154 amperes; hence, the smallest rubber-covered wire (Code rules) that can be safely used is a No. 000, which has a safe capacity of 177 amperes. No. 00, which safely carries 150 amperes, could be probably safely used if the wiring inspector would pass it.

Branch leads to motors must have a carrying capacity 25 per cent in excess of the full-load current ratings of the motors they serve (National Electrical Code). With a main serving several motors the 25 per cent excess capacity is not required.

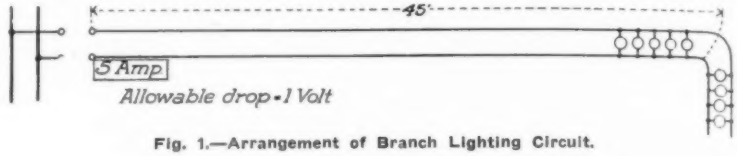


Fig. 1.—Arrangement of Branch Lighting Circuit.

2. Calculations of three-wire, direct-current circuits are made in essentially the same manner as those for direct-current two-wire circuits. With a balanced three-wire circuit, no current flows in the neutral wire, and in practice the circuits should be very nearly balanced; in making wiring calculations it is usally assumed that they are balanced unless there is obviously great unbalance. The first step is to ascertain the current that will flow in the outside wires. This is obtained in practice by adding together the currents taken by all of the receivers connected between the neutral and the outside wires and dividing the sum by 2. (See Fig. 3.) Then to this value are added the currents taken by receivers, if there are any, that are connected across the outside wires. The sum is taken as the total current. The calculation is then made in the same way as for any two-wire circuit. The neutral wire is disregarded in the calculation as it is assumed that it carries no current. The neutral is always made the same size as the outside wires in interior wiring.

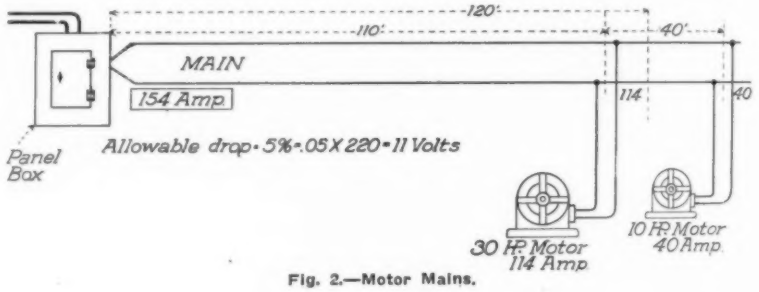


Fig. 2.—Motor Mains.

The drop in voltage E in the foregoing formulas is the drop in the outside wires and is two times the drop to each receiver between neutral and outside wires. Two-wire branch circuits feeding from three-wire mains or feeders are computed in the same manner as for any two-wire circuit.

Example. What size wire should be used for the three-wire mains of Fig. 3? Allowable drop is 3 volts and the distance to the load center is 40 feet. The circuit is loaded with two groups of receivers each taking 60 amperes, connected between the neutral and the outside wires, and one group of receivers taking 20 amperes connected across the outside wires.

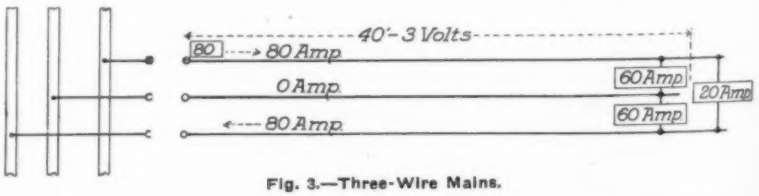


Fig. 3.—Three-Wire Mains.

Solution. Load = [(60 + 60) ÷ 2] + 20 = 80 amperes. Substituting in the formula:

$A = 22\,I\,L \div E = 22 \times 80 \times 40 \div 3 = 23{,}470$ circular mils.

Referring to table of carrying capacities from the National Electrical Code, 23,470 circular mils is seen to correspond most nearly to No. 6 wire, which has a cross-section of 26,250 circular mils. This size of wire would satisfy the voltage-drop requirement; but, for concealed wiring, rubber-covered wire must be used, and rubber-covered No. 6 has a safe carrying capacity of but 46 amperes. The current in the circuit is 80 amperes. Therefore, with rubber-insulated wire, No. 2 should be used, which will safely carry 90 amperes. The neutral wire is made the same size as the outside wires. For exposed wiring with slow-burning or weatherproof insulation, three No. 4 wires, each of which safely carries 92 amperes, could be used.

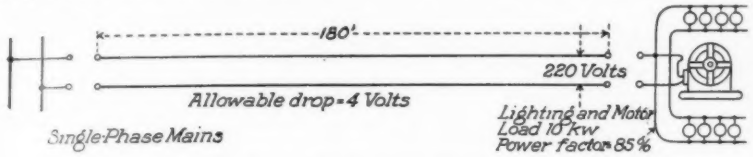


Fig. 4.—Single-Phase Circuit.

Alternating-Current Circuits.

3. In calculating alternating-current circuits there are certain phenomena that must be considered that do not exist with direct-current circuits. Among these are the effects of power-factor and of induction and reactance. Where circuits are short these effects need not always be considered, but where circuits are long they may be of considerable consequence. Electrostatic capacity seldom need be considered with circuits operating at the voltages discussed in this article; namely, pressures below 2,200 volts. Skin effect is usually of so little consequence that it can be neglected.

There is no simple method of calculating alternating-current circuits that takes into account the effects of power-factor and reactance, that is reasonably accurate under all conditions. The methods described in following paragraphs in which the effect of line reactance is not considered, give approximate results, but experience has shown them to be quite accurate enough for many wiring calculations. The results from these approximate formulas are usually subject to less error than other factors entering in to ordinary wiring calculations. The results from the Mershon diagram method which will be described later are quite accurate.

4. Large conductors should not be used for alternating-current circuits. If conductors are too large, the skin effect becomes so great that but a small proportion of the total area of the conductor is effective. Some engineers will use no conductor larger than 300,000 circular mils for interior wiring; but 700,000-circular-mil conductors can be used economically for interior work if they are made up on a fiber core. As a general proposition, conductors larger than 700,000 circular mils are very difficult to install. If, for instance, a carrying capacity equivalent to 800,000 circular mils is required, use two 400,000-circular-mil conductors in parallel or a similar equivalent arrangement.

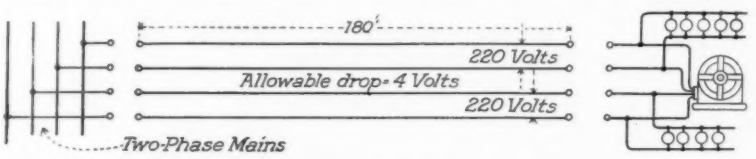


Fig. 5.—Arrangement of Two-Phase Circuit.

5. The power-factor of the load, apparatus or equipment must often be known before alternating-current wiring calculations can be made. If the exact power-factor of the load is not known or cannot readily be obtained, for ordinary wiring calculations it can be assumed that power-factors of loads will be as follows: Incandescent lighting load, from 100 per cent to 95 per cent; incandescent lighting and motors, 85 per cent; motors, only 80 per cent. The power-factor of the load, if it be other than 100 per cent, may affect the volts loss in the line considerably. (See examples in the following paragraphs.)

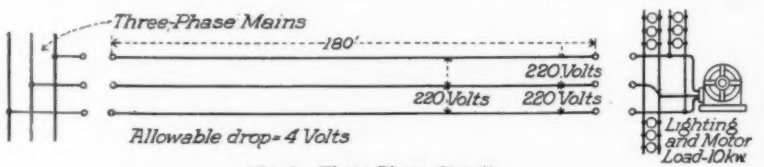


Fig. 6.—Three-Phase Circuit.

6. *Effect of line reactance.* Practically all alternating-current circuits have some line reactance. The effect of reactance is to cause a drop in voltage somewhat similar to that caused by resistance. Where all of the wires of a circuit—two wires for a single-phase, four wires for a two-phase, and three wires for a three-phase circuit—are carried in the same conduit or where the wires are separated less than an inch between centers, the effect of line reactance may ordinarily be neglected. Where circuit conductors are large and widely separated from one another and the circuits are long, the effect of inductive reactance may increase the volts line loss considerably over that due to resistance alone. Every such case should be investigated with the Mershon diagram. (Fig. 14.) With aerial circuits on pole lines, where the wires are widely separated, the effect of reactance is apt to be large. Line reactance decreases somewhat as the size of wire decreases, and decreases also as the distance between wires decreases. (See table for calculating drop in alternating-current lines with the Mershon diagram.)

7. Line or circuit reactance with a conductor of given area can be reduced in two ways. One of these is to diminish the distance between wires. The extent to which this can be carried is limited in the case of a pole line to the least distance at which the wires are safe from swinging together in the middle of a span. In inside wiring, knob or cleat work, it is limited by the separation distances required by the underwriters. In conduit work the conductors lie so close together that there is very little effect from inductive reactance under ordinary conditions. The other way of reducing reactance is to divide the copper into a greater number of circuits. Voltage drop in lines due to inductive reactance is best diminished by bringing the conductors closer together. It is little affected by changing the size of conductor. In a following paragraph there is a problem illustrating this, and its solution.

8. The following method, though not strictly accurate, can be used for ordinary interior single-phase wiring where the power-factor of the load is nearly 100 per cent, as with incandescent lamps: Treat the circuits as if they were direct-current circuits, using the formula of Paragraph 1. (See example following that paragraph.) If the circuits are very long and the wires widely separated use the method of Paragraph 14.

9. Three-wire, single-phase, alternating-current circuits can be calculated, provided they are of moderate length, with the three-wire direct-current formula, of Paragraph 2. If the circuit is quite long and the wires widely separated use the method of Paragraph 15. Treat the circuit as a single-phase circuit of the voltage between the two outside wires of the

TABLE I FOR CALCULATING DROP IN ALTERNATING-CURRENT LINES WITH THE MERSHON DIAGRAM.

FREQUENCY—60 CYCLES.

Size of Wire, B. & S. Gauge and Circular Mils.	Safe Carrying Capacity—Amperes. Rubber Insulation.	Other Insulation.	Resistance Volts in 1,000 Feet of Line (2,000 Feet of Wire) for One Ampere.[1]	Reactance volts in 1,000 feet of line (= 2,000 feet of wire) for one ampere at 60 cycles per second for the distances given in inches between centers of conductors.[2] 0.5 Inch.	1 Inch.	2 Inches.	3 Inches.	4 Inches.	5 Inches.	6 Inches.	9 Inches.	12 Inches.	18 Inches.	24 Inches.
14— 4,107	12	16	5.06	0.138	0.178	0.218	0.220	0.233	0.244	0.252	0.271	0.284	0.302	....
12— 6,530	17	23	3.18	0.127	0.159	0.190	0.248	0.223	0.233	0.241	0.260	0.273	0.292	....
10— 10,380	24	32	2.00	0.116	0.148	0.180	0.199	0.265	0.223	0.221	0.249	0.262	0.281	....
8— 16,510	33	46	1.26	0.106	0.138	0.169	0.188	0.215	0.212	0.220	0.238	0.252	0.270	0.284
6— 26,250	46	65	0.790	0.095	0.127	0.158	0.178	0.190	0.210	0.209	0.228	0.241	0.260	0.274
4— 41,740	65	92	0.498	0.085	0.117	0.149	0.167	0.180	0.190	0.199	0.217	0.230	0.249	0.262
2— 66,370	90	131	0.312	0.074	0.106	0.138	0.156	0.169	0.180	0.188	0.206	0.220	0.238	0.252
1— 83,690	107	156	0.248	0.068	0.101	0.132	0.151	0.164	0.174	0.183	0.201	0.214	0.233	0.246
0—105,500	127	185	0.196	0.063	0.095	0.127	0.145	0.159	0.169	0.177	0.196	0.209	0.228	0.241
2/0—133,100	150	220	0.156	0.057	0.090	0.121	0.140	0.153	0.164	0.172	0.190	0.204	0.222	0.236
3/0—167,800	177	262	0.122	0.052	0.085	0.116	0.135	0.148	0.158	0.167	0.185	0.199	0.217	0.230
4/0—211,600	210	312	0.098	0.046	0.079	0.111	0.130	0.143	0.153	0.161	0.180	0.193	0.212	0.225
250,000	235	250	0.085	....	0.075	0.106	0.125	0.139	0.148	0.157	0.175	0.189	0.207	0.220
300,000	270	400	0.075	....	0.071	0.103	0.120	0.134	0.144	0.153	0.171	0.185	0.220	0.217
350,000	300	450	0.061	....	0.067	0.099	0.118	0.128	0.141	0.149	0.168	0.182	0.200	0.213
400,000	330	500	0.052	....	0.064	0.096	0.114	0.127	0.138	0.146	0.165	0.178	0.197	0.209
500,000	390	590	0.042	....	....	0.090	0.109	0.122	0.133	0.141	0.160	0.172	0.192	0.202
600,000	450	680	0.035	....	....	0.087	0.106	0.118	0.128	0.137	0.155	0.169	0.187	0.200
700,000	500	760	0.030	....	....	0.083	0.102	0.114	0.125	0.133	0.152	0.165	0.184	0.197
800,000	550	840	0.026	....	....	0.080	0.099	0.112	0.122	0.130	0.148	0.162	0.181	0.194
900,000	600	920	0.024	....	....	0.077	0.096	0.109	0.119	0.127	0.146	0.159	0.178	0.191
1,000,000	650	1,000	0.022	....	....	0.075	0.094	0.106	0.117	0.125	0.144	0.158	0.176	0.188

[1] The values in this column are really the resistances of 2,000 feet of conductor at 75 degrees Fahrenheit.
[2] The values in these columns are really the reactances of 2,000 feet of conductor.

FREQUENCY—25 CYCLES.

Size of Wire, B. & S. Gauge and Circular Mils.	Safe Carrying Capacity—Amperes. Rubber Insulation.	Other Insulation.	Resistance Volts in 1,000 Feet of Line (2,000 Feet of Wire) for One Ampere.[1]	Reactance volts in 1,000 feet of line (= 2,000 feet of wire) for one ampere at 25 cycles per second for the distances given in inches between centers of conductors.[2] 0.5 Inch.	1 Inch.	2 Inches.	3 Inches.	4 Inches.	5 Inches.	6 Inches.	9 Inches.	12 Inches.	18 Inches.	24 Inches.
14— 4,107	12	16	5.06	0.057	0.071	0.084	0.093	0.097	0.102	0.105	0.113	0.118	0.126	....
12— 6,540	17	23	3.18	0.053	0.066	0.080	0.087	0.094	0.097	0.101	0.108	0.113	0.122	....
10— 10,380	24	32	2.00	0.049	0.062	0.075	0.083	0.088	0.092	0.096	0.104	0.110	0.117	....
8— 16,510	33	46	1.26	0.044	0.057	0.071	0.078	0.084	0.088	0.092	0.099	0.105	0.113	....
6— 26,250	46	65	0.790	0.040	0.053	0.066	0.074	0.079	0.084	0.087	0.095	0.100	0.108	....
4— 41,740	65	92	0.498	0.035	0.049	0.062	0.070	0.075	0.079	0.083	0.091	0.096	0.104	....
2— 66,370	90	131	0.312	0.031	0.044	0.057	0.065	0.071	0.075	0.078	0.086	0.092	0.099	....
1— 83,690	107	156	0.248	0.028	0.042	0.055	0.063	0.068	0.073	0.076	0.083	0.089	0.097	....
0—105,500	127	185	0.196	0.026	0.040	0.053	0.061	0.066	0.070	0.073	0.082	0.087	0.095	....
2/0—133,100	150	220	0.156	0.024	0.037	0.051	0.058	0.064	0.068	0.072	0.079	0.085	0.093	....
3/0—167,800	177	262	0.122	0.022	0.035	0.048	0.056	0.062	0.066	0.070	0.077	0.083	0.091	....
4/0—211,600	210	312	0.098	0.019	0.032	0.046	0.053	0.059	0.064	0.067	0.075	0.081	0.088	....
250,000	235	250	0.085	....	0.031	0.044	0.051	0.058	0.062	0.065	0.073	0.079	0.086	0.092
300,000	270	400	0.075	....	0.030	0.043	0.050	0.056	0.060	0.064	0.071	0.077	0.084	0.090
350,000	300	450	0.061	....	0.028	0.041	0.049	0.054	0.059	0.062	0.070	0.076	0.082	0.089
400,000	330	500	0.052	....	0.027	0.040	0.048	0.053	0.057	0.061	0.069	0.075	0.082	0.087
500,000	390	590	0.042	....	....	0.038	0.046	0.051	0.055	0.059	0.067	0.072	0.080	0.085
600,000	450	680	0.035	....	....	0.036	0.044	0.049	0.053	0.057	0.065	0.070	0.078	0.083
700,000	500	760	0.030	....	....	0.035	0.042	0.048	0.052	0.056	0.063	0.069	0.077	0.082
800,000	550	840	0.026	....	....	0.033	0.041	0.047	0.050	0.054	0.062	0.068	0.075	0.081
900,000	600	920	0.024	....	....	0.032	0.040	0.046	0.050	0.053	0.061	0.066	0.074	0.080
1,000,000	650	1,000	0.022	....	....	0.031	0.039	0.044	0.049	0.052	0.060	0.065	0.073	0.079

[1] The values in this column are really the resistances of 2,000 feet of conductor at 75 degrees Fahrenheit.
[2] The values in these columns are really the reactances of 2,000 feet of conductor.

three-wire system, disregarding the neutral wire. Then make the neutral wire the same size as is found for the two outside wires.

10. This method, although not strictly accurate, can be safely used for computing short branch circuits and also feeders and mains where the circuits are carried in conduit or are not very long. Where the circuits are of considerable length, the method of Paragraph 15 should be used. If the current is not known, it must be found, using this formula:

$$I = P \times 1{,}000 \div E \times p;$$

where, I is the current in amperes, P the kilowatts input of load, E the voltage of circuit, and p the power-factor of load. The current being known, use this formula:

$$A = 22 \times I \times L \div V;$$

where A is the cross-section of the conductor in circular mils, I, the current in amperes, L the single distance or length one way of the circuit, in feet, and V the volts drop allowable.

Example. Load equals 10 kilowatts; voltage of circuit, 220; power-factor, 0.85; distance, 180 feet; allowable drop, 4 volts. (See Fig. 4.) What size wire should be used?

Solution. Substituting in the formula:

$$I = P \times 1{,}000 \div E \times p = 10 \times 1{,}000 \div 220 \times 0.85 = 53.5 \text{ amperes.}$$

Then to find the size of conductor:

$$A = 22\ I\ L \div V = 22 \times 53.5 \times 180 \div 4 = 52{,}700 \text{ circular mils.}$$

Referring to table of carrying capacities, the next larger standard size wire is No. 2 (66,370 circular mils). It safely carries 90 amperes, and so is ample for the 53.5 amperes of this problem.

11. In the calculation of two-phase, four-wire, alternating-current circuits where line reactance can be neglected, the following method, although not strictly accurate, can be safely used for computing short branch circuits, and also feeders and mains where the circuits are carried in conduit or are not very long. Where circuits are of considerable length, the method of Paragraph 16 should be used. If the current is not known, it must be found using this formula:

$$I = P \times 1{,}000 \div E \times p \times 2;$$

where I is the current in amperes in each of the four wires, E is the voltage across each of the two phases, P is the kilowatts input to load, and p the power-factor of the load. The current being known:

$$A = 22\ I\ L \div V;$$

where A is the area of required conductor, I the current in amperes in each of the four wires, L the length or single distance of the circuit in feet, and V the volts drop to be allowed in the circuit.

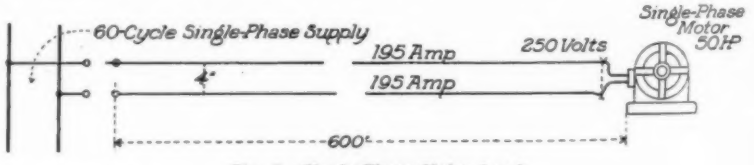


Fig. 7.—Single-Phase Motor Load.

Example. See Fig. 5. Load equals 10 kilowatts; voltage of circuit, 220; power factor, 0.85; distance, 180 feet; allowable drop, 4 volts. What size wire should be used?

Solution. Substitute in the formula:

$I = P \times 500 \div E \times p = 10 \times 500 \div 220 \times 0.85 =$ 26.8 amperes.

Then to find the size conductor,

$A = 22\ I\ L \div V = 22 \times 26.8 \times 180 \div 4 =$ 26,500 circular mils.

Referring to table of carrying capacities, the next larger standard size wire is No. 5, which has an area of 33,100 circular mils, and which will safely carry, with rubber insulation, 54 amperes, and with other insulations, 77 amperes. It will, therefore, with either insulation, readily carry the 26.8 amperes in this circuit. Four No. 5 conductors would be used.

12. In the calculation of three-phase, three-wire, alternating-current circuits where line reactance can be neglected, this method, although not strictly accurate, can be safely used for ordinary branch circuits and also for computing feeders and mains where the circuits are carried in conduit, or are not very long. Where circuits are of considerable length, the method of Paragraph 17 should be used. If the current is not known, it must be found, using this formula:

$I = P \times 1{,}000 \div E \times p \times 1.73 = P \times 580 \div E \times p;$

where I is the current in amperes in each of the three wires; E the voltage between wires; P the kilowatts input to load, and p the power-factor of the load. The current being known, the wire size can be calculated thus:

$A = 11 \times I \times L \times 1.73 \div V = 19\ I\ L \div V$; where A is the area for each of the three wires; I the current in each of the three wires in amperes; L the single distance or length one way of the circuit in feet, and V the allowable volts drop in line.

Example. Load equals 10 kilowatts; voltage of circuit, 220; power-factor, 0.85; distance, 180 feet; allowable drop, 4 volts. (See Fig. 6.) What size wire should be used?

Solution. Substitution in the formula:

$I = 580 \times P \div E \times p$

$= 580 \times 10 \div 220 \times 0.85 = 31$ amperes.

Then to find the conductor size:

$A = 19\ I\ L \div V = 19 \times 31 \times 180 \div 4 =$ 26,500 circular mils.

Referring to the table of current carrying capacities, the next larger standard size wire is No. 5, which has an area of 33,100 circular mils. It will safely carry, with rubber insulation, 54 amperes, and with other insulations 77 amperes. It is therefore ample in size for the 31 amperes of this problem. Three No. 5 wires would therefore be used for the circuit.

13. Single-phase branches from three-phase circuits are calculated the same as any single-phase circuit. If the two branch conductors are tapped from two of the conductors of a three-wire, three-phase circuit, the voltage across the branch wires will be the same as that across any two of the wires of the three-phase circuit. If the branch is connected between one of the three wires and the neutral, the voltage across the branch wires will be 58 per cent of the three-phase voltage between the phase wires.

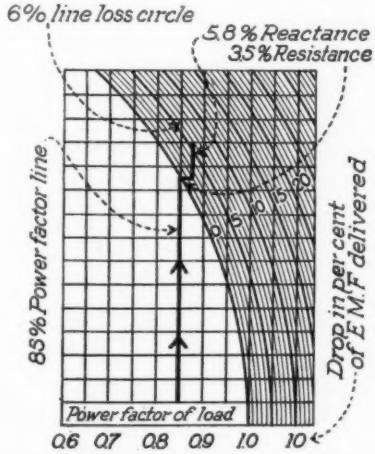

6% line loss circle
5.8% Reactance
3.5% Resistance
85% Power factor line
Drop in per cent of E.M.F delivered
Power factor of load
0.6 0.7 0.8 0.9 1.0

Fig. 8.—Use of Mershon Diagram.

14. The Mershon diagram (Fig. 14) is recommended for the calculation of circuits where line reactance must be considered. Other and apparently simpler methods are available, but all simple methods are inaccurate under certain conditions, and are apt to get their user into trouble unless he is quite familiar with the principles of alternating currents. The Mershon diagram does not offer a direct method of ascertaining drop. It is, rather, a cut-and-try method. The distance between wires and the frequency of the circuit being known, a conductor of a size that appears to be about right is selected for trial. With the current flowing known, the volts line loss in this conductor can be determined with the diagram. If the volts line loss in this conductor is found to be excessive a different size conductor is tried. Trials are made until a size conductor is found that will bring the drop within the specified limit. It is seldom that more than two trials are necessary. The method is a little tedious but not difficult. It is accurate under all ordinary conditions. See the examples that follow

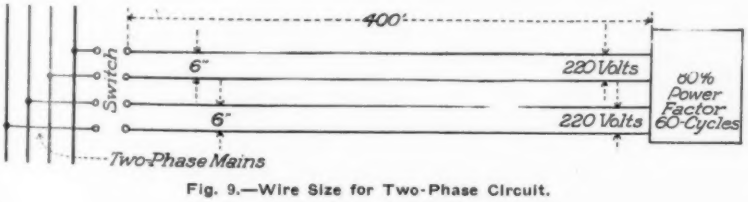


Fig. 9.—Wire Size for Two-Phase Circuit.

15. The use of the Mershon diagram in computing single-phase alternating-current circuits where line reactance must be considered can best be explained by examples.

Example. What size wire should be used for the branch to the 50-horsepower, 60-cycle, 250-volt, single-phase induction motor of Fig. 7? The name-plate current rating of the motor is 195 amperes, and its full load power factor is 85 per cent. The wires are run open and separated 4 inches. Length of circuit is 600 feet. The volts line loss must not exceed 6 per cent, or 15 volts.

Solution. To ascertain approximately what size the conductor must be, use the simple single-phase formula:

$A = 22\ I\ L \div V = 22 \times 195 \times 600 \div 15$

$= 171{,}500$ circular mils.

Referring to table of current carrying capacities, the next larger standard size wire is No. 0000 (211,600 circular mils). This size wire would be ample if there were no line reactance, but as it is known that there is line reactance we will select a larger conductor and find what the volts loss with it will be, using the Mershon diagram, Fig. 14. Try a 300,000-circular-mil conductor. Find the resistance and reactance drops in the line using the values from Table I for a 300,000-circular-mil conductor, for 60 cycles and a 4-inch separation. From the table, resistance volts $= 0.075$ and reactance volts $= 0.134$.

Resistance drop = current × resistance volts × distance ÷ 1,000

$= 195 \times 0.075 \times 600 \div 1{,}000 = 8.8$ volts.

Percentage resistance drop = resistance drop ÷ receiver volts $= 8.8 \div 250 = 3.5$ per cent.

Reactance drop = current × reactance volts × distance ÷ 1,000

$= 195 \times 0.134 \times 600 \div 1{,}000 = 15.2$ volts.

Percentage reactance drop = reactance drop ÷ receiver volts $= 15.2 \div 250 = 5.8$ per cent.

Refer to the Mershon diagram (Fig. 8). Follow the vertical line corresponding to the power-factor, 0.85, upward until it intersects the smallest circle marked 0 as illustrated in Fig. 8. From this point lay off horizontally the percentage resistance drop, 3.5. From this last point lay off vertically the percentage reactance drop, 5.8. (See Fig. 8.) This last point lies about on the 6 per cent circle indicating that the volts line loss in this circuit with 195 amperes flowing will be 0.06 × 250, or 15 volts. The conditions of the example are satisfied by a 300,000-circular-mil conductor, and this size of conductor would be used in running the circuit.

Inasmuch as this is a motor branch, the Code rules require that its safe carrying capacity be sufficient for a 25 per cent overload. Therefore the conductor should

be capable of safely carrying 195 × 1.25, or 244 amperes. Referring to Table I, a 300,000-circular mil, rubber-insulated cable would be required to safely carry this 244 amperes. In a problem in practice one would therefore immediately try a 300,000-circular-mil conductor for volts line loss. The preliminary calculations were given in the above problem to illustrate the method.

16. In the calculation of two-phase, four-wire, alternating-current circuits where line reactance must be considered, use the Mershon diagram, Fig. 14. Calculate the single-phase circuit required to transmit one-half the power at the same voltage. The two-phase transmission will require two such circuits.

Example. What size of wire should be used for the two-phase circuit of Fig. 9? Load equals 116.5 kilowatts; receiver voltage, 220; load power-factor, 80 per cent; frequency, 60 cycles; length of circuit, 400 feet; distance between wires, 6 inches.

Solution. Find one-half of the total load on the circuit and then proceed with this one-half total load as if it were the entire load on a single-phase circuit.

One-half total load = 120 × 1000 ÷ 2 = 60,000 watts.

Line current = $P \div E \times p$ = 60,000 ÷ 220 × 0.80 = 331 amperes.

To ascertain approximately what size wire should be installed, use the approximate two-phase formula:

$A = 22\ I\ L \div V$ = 22 × 331 × 400 ÷ 12 = 234,000 circular mils.

The next larger standard size wire is 300,000 circular mils, which will safely carry the current, 331 amperes, (see Table I), if the wires are run open. If they are concealed—rubber-insulated—at least a 400,000-circular-mil conductor must be used.

Referring to Table I, for a 300,000-circular-mil conductor, 6-inch separation, and 60 cycles: Resistance volts per ampere = 0.075, and reactance volts per ampere = 0.153; therefore:

Resistance drop = current × resistance volts × distance ÷ 1000

= 331 × 0.075 × 400 ÷ 1000 = 9.9 volts.

Percentage resistance drop = 9.9 ÷ 220 = 4.5 per cent.

Reactance drop = current × reactance volts × distance ÷ 1000

= 331 × 0.153 × 400 ÷ 1000 = 20.2 volts.

Percentage reactance drop = 20.2 ÷ 220 = 9.2 per cent.

Lay out the percentage resistance and reactance drops on the Mershon diagram (Fig. 14), for 0.80 power-factor, as suggested in the single-phase problem above, and as illustrated in Fig. 11. The last point on the layout is between the 9-per-cent and the 10-per-cent volts-loss circles in the diagram, indicating that the volts loss with 300,000-circular-mil conductors would be about 9.5 per cent. The allowable loss is but 5 per cent; so a different size conductor must be selected. A conductor larger than 300,000 circular mil might be selected that would bring the volts line loss within the 5 per cent limit, but it is probably better to install two two-phase transmissions of smaller wire in multiple as shown in Fig. 10, making the aggregate area of the two conductors in multiple equal to about 300,000 circular mils. Therefore, try two transmissions of No. 00 wire. Take values for No. 00 wire from Table I in the same manner as before, for 60 cycles, and a 6-inch separation, remembering that half the former current will flow in the conductors of the subdivided transmission. Then, for each two-phase, two-wire circuit the current will be 0.5 × 331, or 166 amperes. Therefore

Resistance drop = current × resistance volts × distance ÷ 1000.

= 166 × 0.156 × 400 ÷ 1000 = 10.7 volts.

Percentage resistance drop = 10.7 ÷ 220 = 4.7 per cent.

Reactance drop = current × reactance volts × distance ÷ 1000

= 166 × .172 × 400 ÷ 1000 = 11.4 volts.

Percentage reactance drop = 11.4 ÷ 220 = 5.2 per cent.

Laying the percentage resistance and percentage reactance drops out on the Mershon diagram at 0.80 power-factor, it will be found that for this No. 00 wire the percentage volts line loss will be about 6.5, which is excessive.

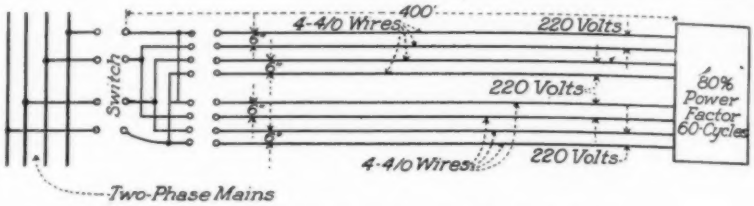


Fig. 10.—Wires in Multiple to Decrease Effect of Reactance.

Making another trial, considering this time two two-phase transmissions of No. 0000 wire in parallel, it will be found that the percentage volts line loss will be just a trifle over 5. So two two-phase circuits in parallel of No. 0000 wire would be used as shown in Fig. 10.

This is an unusually tedious problem and was selected to indicate the method of dividing a given transmission into two transmissions of smaller wire to decrease the effect of line reactance. In practice, it might not be the most economical method to install the transmission, as indicated in Fig. 10.

17. In calculation of a three-phase, three-wire, alternating-current circuit where line reactance must be considered, use the Mershon diagram, Fig. 14. Calculate a single-phase circuit to carry one-half the load at the same voltage. The three-phase transmission will require three wires of the size and distance between centers as obtained for the single-phase circuit.

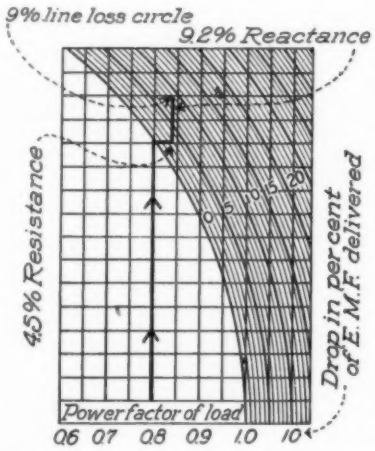

9% line loss circle
9.2% Reactance
4.5% Resistance
0 5 10 15 20
Drop in per cent of E.M.F. delivered
Power factor of load
06 07 08 09 10 10+

Fig. 11.—Another Application of Mershon Diagram.

Example. What size conductor should be used for the open-wire transmission shown in Fig. 12—the allowable volts loss in the line being 4 per cent, or 8.8 volts; receiver voltage, 220; load, 50 kilowatts; power-factor, 0.80; distance, 200 feet; distance between wires, 3 inches?

Solution. The actual current in each wire must be known to insure a conductor large enough to carry it will be selected.

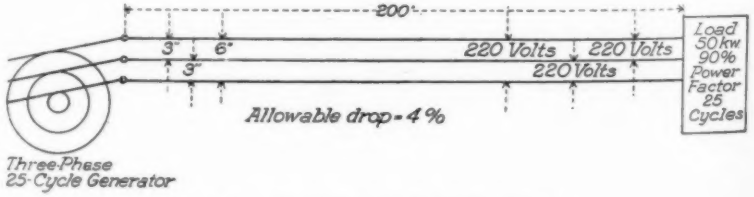


Fig. 12.—Three-Phase 25-Cycle Circuit.

Actual current = 0.58 $P \div E \times p$ = 0.58 × 50,000 ÷ 220 × 0.8 = 165 amperes.

Now find one-half of the total load and proceed with this load as for a single-phase transmission, which will be called the imaginary transmission.

One-half total load = watts ÷ 2 = 50,000 ÷ 2 = 25,000 watts.

The current in the imaginary transmission would be $I = P \div (E \times p) = 25{,}000 \div 220 \times 0.8 = 142$ amperes.

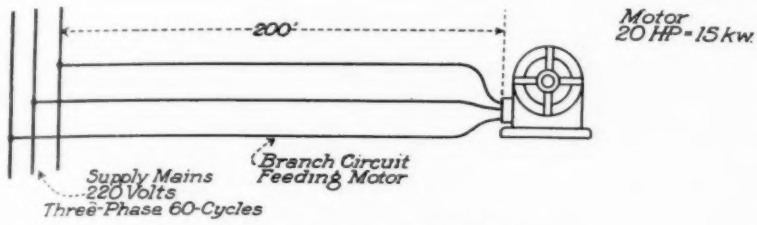


Fig. 13.—Example in Motor Wiring.

To approximate the size of wire, use the single-phase formula:

$22\ I\ L \div V = 22 \times 142 \times 200 \div 8.8 = 71{,}000$ circular mils.

The next larger standard size wire is No. 1, which will safely carry, when exposed, 156 amperes. The actual current is 142 amperes. No. 1 is therefore, satisfactory from a current-carrying standpoint. Now check it for volts line loss.

The average distance between the three wires is 4 inches. Refer to Table I, under 25 cycles, and opposite No. 1 wire and find: Resistance volts per 1000 feet equal 0.248, and (under 4-inch separation) reactance volts per 1000 feet, 0.068. Then

Resistance drop = current × resistance volts × distance ÷ 1000

$= 142 \times 0.248 \times 200 \div 1000 = 7.05$ volts.

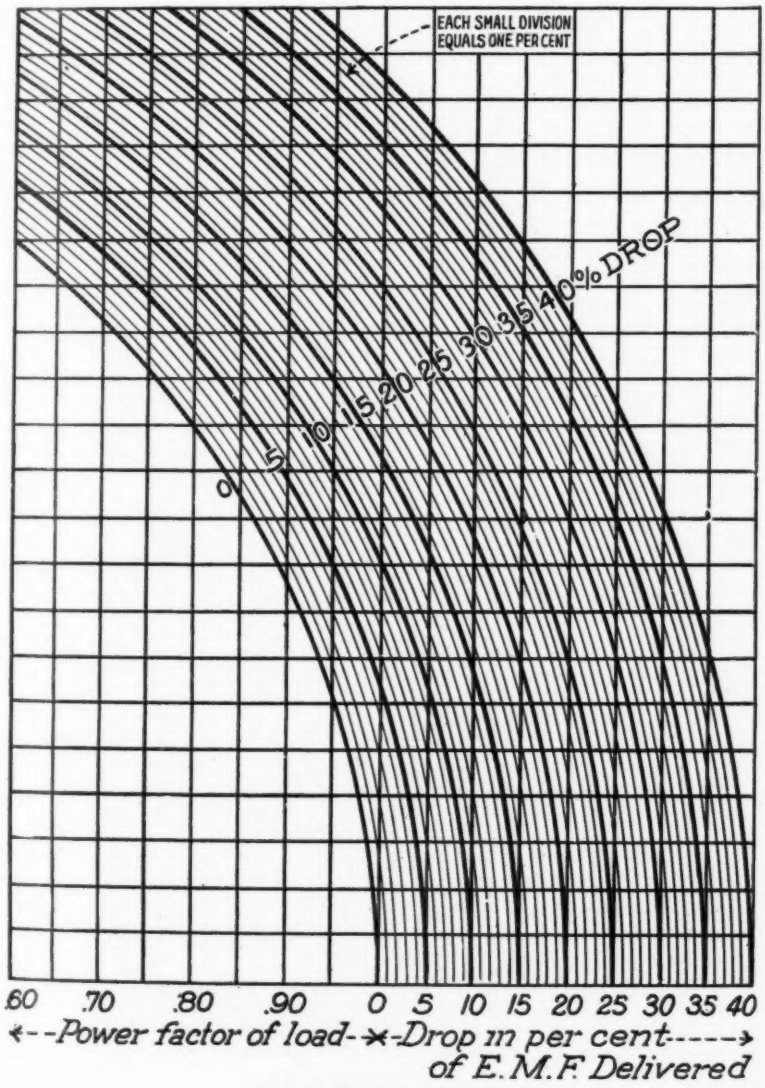


Fig. 14.—Mershon Diagram.

Percentage resistance drop = 7.05 ÷ 220 = 3.2 per cent.

Reactance drop = current × reactance volts × distance ÷ 1000

$= 142 \times 0.068 \times 200 \div 1000 = 1.93$ volts.

Percentage reactance drop = 1.93 ÷ 220 = 0.88 per cent.

Laying out the percentage resistance drop and the percentage reactance drop on the Mershon diagram (Fig. 14), at the upper end of the 90-per-cent power-factor line, as described under the single-phase problem of Paragraph 15, the last point of the layout comes just under the 4 per cent volts loss circle. Therefore, the true volts loss in the line will be somewhat less than 4 per cent with No. 1 wire. Therefore, use three No. 1 wires for the transmission as shown in Fig. 12. Study the examples of Paragraphs 15 and 16, for other features of the Mershon diagram.

18. *How to use the Mershon diagram.* To recapitulate: refer to Table I, calculate the resistance volts and the reactance volts in the line, and find what per cent each is of the electromotive force delivered at the end of the line. Starting from the point on the chart (Fig. 14) where the vertical line corresponding with power-factor of the load intersects the smallest circle, lay off in per cent the resistance electromotive force horizontally and to the right; from the point thus obtained lay off upward in per cent the reactance electromotive force. The circle on which the last point falls gives the drop in per cent of the electromotive force delivered at the end of the line. Every tenth circle arc is marked with the per-cent drop to which it corresponds.

19. Taking 11 ohms as the resistance of a circular-mil-foot of commercial copper wire at 75 degrees Fahrenheit, the power loss in any conductor may be found thus:

$$P = 11 \times I^2 \times L \div A;$$

where P is power lost in the conductor in watts; I, the current in amperes in the conductor; L, length of the conductor in feet, and A, cross-section of the conductor in circular mils.

It follows from the above formula that for a two-wire, direct-current or a single-phase circuit:

$$P = 2 \times 11 \times I^2 \times L \div A.$$

For a balanced four-wire, two-phase circuit

$$P = 44 \times I^2 \times L \div A.$$

For a balanced three-wire, three-phase circuit

$$P = 33 \times I^2 \times L \div A.$$

The above formulas can be used only when all of the wires of the line are of the same size.

20. A problem to be worked out by the above method is presented in Fig. 13, which represents a 20-horsepower motor at the end of three-phase, 60-cycle, 220-volt circuit, 200 feet in length. The power-factor may be assumed to be 0.75. It is left to the reader to find the proper size of leads.

Cards for Use in House Wiring.

In Figs. 1 and 2 there are shown the front and the reverse sides of a handy little card used by the Wentworth-Dean Company, of Lima, O., in keeping records in house wiring. Fig. 1 is the front side of the card and Fig. 2 the reverse side. The card, which is made of a good grade of cardboard, is of a size convenient for carrying in the pocket or for filing.

It will be noted that space is supplied for recording most of such data as it might be necessary to refer to frequently on houses of a number of types. There are spaces for the names of the owner and the person with whom the contract for the wiring is made, the various necessary dates, the location and the number of the job, the number of circuits, the number and kinds of switches to be used, the number and location of outlets, etc. The form is one well worth the consideration of other electrical contractors.

The Wentworth-Dean Co. **HOUSE WIRING.**

Owner..... ....., **Location** ....

Contract with..... .... **Job No**.....

Total Outlets..... ..... **Light Outlets** .... **Sw. Outlets**.....

To be roughed in..... ..... **To be finished** .....

Meter outlet located..... ..... **No. Circuits**.....

FOLLOWING TO BE FILLED IN BY WORKMAN

No. Snap Sw. S. P...... **No. 3 way snaps**.....

No. Flush " S. P. .... **No. 3 way flush**.....

No. Single boxes..... ..... **No. 2 gangs**..... **No. 3 gangs**.....

Date started .... **Roughed in by** ....

Date finished..... **Finished by**..... .....

Fig. 1.—Face of Card.

Location	No. Outlets	Switch
Basement	.....	Sw.....
1st floor		
Front Porch	.....	Sw.....
Parlor	.....	" .....
Recpt. Hall	.....	" .....
Hall	.....	" .....
Sitting Rm	.....	" .....
Dining Rm	.....	" .....
Kitchen	.....	" .....
Pantry	.....	" .....
Back Porch	.....	" .....
Closets	.....	" .....
2nd floor		
Hall	.....	" .....
Bath Rm	.....	" .....
Bed Rm	.....	" .....
" "	.....	" .....
" "	.....	" .....
" "	.....	" .....
Closets	.....	" .....
Attic	.....	" .....
Door Bell	.....Location.....	
No. Pushes.....	"	.....
Drops.....		

Fig. 2.—Reverse Side of Card.

Among the Contractors.

The Burdorf-Brecher Company, dealer in electric light fixtures in Louisville, Ky., has secured one of the most important contracts of the year, that for the fixtures in the new $350,000 Y. M. C. A. building in Louisville.

The D. F. Lackey Electrical Company, Peoria, Ill., has been awarded contract for the electrical work in the nine-story annex to the Shipper & Block department store in Peoria. The contract aggregates about $10,000.

The Kollker Electric Company, of Evansville, Ind., has been engaged to install a white-way lighting system on Eighth Street, in Tell City, Ind. Twelve blocks of this street will be equipped with ornamental lighting standards supporting 14-inch alabaster globes containing 250-watt tungsten lamps. All wires will be laid underground and steel-taped lead-covered cables are to be used.

The Richardson Electric Company of Duluth, Minn., has secured the contract to install the electrical equipment, such as wiring, switchboards, motor-generator sets, motors, fire-alarm system, etc., in the R. E. Denfeld High School about to be erected in Duluth.

A new contracting business is that recently formed under the name of E. V. Stacey, at 1526 Prospect Avenue, Cleveland, O. In addition to a general electrical contracting business, a line of supplies and heating appliances are carried in stock.

The Berg-Clark Electric Company is the firm name of an electrical contracting company recently established in Cleveland, O., at 10308 Euclid Avenue, under the management of C. Berg. Mr. Berg is a man of broad experience in the electrical contracting line and has selected a very desirable location.

The Nashville Armature Works, Nashville, Tenn., has secured important contracts for electrical work at Monterey, that state. This work includes the installation of generators, transformers, etc., and both interior and outside wiring.

Convention of Illinois Contractors.

The regular semi-annual convention of the Electrical Contractors' Association of the State of Illinois will be held at the Hotel Sherman, Chicago, on June 20 and 21. The president of the Association is William McGuineas, and the secretary is N. M. Blumenthal, of Chicago.

Program of Annual Convention of National Electrical Contractors' Association.

Arrangements are rapidly being completed for the assembling of electrical contractors from over the United States in the thirteenth annual convention of the National Electrical Contractors' Association at Chattanooga, Tenn., next month.

The convention headquarters will be at Hotel Patten, where will be located the registration bureau, and where all open and business sessions will be held. A tentative program of the convention follows:

July 15.

Directors' Meeting, Hotel Patten.

July 16.

Open session at 10 a. m.; speakers on subjects of general interest to the trade; business session for members only at 2 p. m.; lecture on illumination, 7 p. m.; Rejuvenation, Sons of Jove, 9 p. m.; reception and dance at 8 p. m.—Genuine negro cake walk.

July 17.

Business session, for members only, 10 a. m.; trip to Chickamauga Park and Fort Oglethorpe.

July 18.

Business sessions for members only; afternoon tea for ladies and guests at Hotel Patten, given by the Chattanooga Electric Club; annual dinner for ladies, guests and members.

July 19.

Trip to Signal Mountain; lunch, Signal Mountain Inn; return to Union Station in Chattanooga, and take special train for trip to Tennessee Lock and Dam.

Thirty Years Ago.

Electrical News of 1883 as Presented in the "Electrical Review," the Pioneer Electrical Weekly of the United States—Thirteenth Installment.

(From "Electrical Review," New York, June 14, 1883.)

Telephone transmitters should be painted "yeller."

It is reported from Vienna that the firm of Siemens & Halske has applied to the Austrian Government for permission to undertake preparatory work requisite for the construction of electric railways in that city.

The tallest electric mast in the country has been erected in Minneapolis, Minn. It is surmounted with eight lights, each of 4,000 candlepower, which diffuse light enough to enable anybody within a radius of one mile to tell the time by his watch at night.

FROM "ELECTRICAL NOTES": Like many others interested in the success of electric lighting, I have been pleased to observe that the ELECTRICAL REVIEW, which is the leading electrical authority in this country, has at all times evinced confidence in the ultimate triumph of the incandescent system. Each succeeding month brings with it additional evidence of the correctness of this view.

C. F. Brush has patented a device by which he hopes to preserve the filaments of incandescent lamps from what has been called "molecular bombardment." He inserts a screen of mica between the legs of the filament, and thinks thereby to intercept the minute particles of carbon which are torn off and propelled from one leg against the other, a process which eventually weakens and aids in the destruction of the filament.

J. F. Martin, president of the Air-Chamber Wire Insulating Company, is the inventor of a number of devices whose object is to overcome the obstacles in the way of underground telegraphy. In a terracotta or earthenware pipe he incloses a number of small tubes made of paper and asphaltum. These pass through and are supported by wooden or compressed disks perforated and set inside the main, about six feet apart. Through the small tubes, which are said to be perfect insulators, will run telegraph, telephone and electric light wires.

PLANS FOR AN ELECTRICAL COLLEGE.—Elisha Gray, the celebrated electrician and inventor, has purchased the entire frontage between his residence on Laurel Avenue and the railroad at Highland Park, Ill., for the establishment of an electrical college and experimental laboratory, and will, as soon as possible, begin the erection of a first-class building for the purpose, filled with powerful engines for generating electricity. His own house, the building itself, and Highland Hall, of which he is president, will be lighted by electricity and heated by steam from the same power plant. This will be the most extensive enterprise of the kind in the country.

The introduction of domestic labor-saving machines has been almost prevented, but if a means of working them by power, as in the Edison system, were provided, without any danger or trouble from steam, gas or batteries, their number would increase by bounds, and the domestic motor would become as universal as the sewing or the washing machine. Edison's idea—and one, too, that there is a fair reason to believe he will be enabled to carry out—is to furnish small manufacturers not only with light, but also with power—say, from one to ten horsepower. This would save them the cost of engine, fuel and engineer, and would give remunerative employment for the great engines, which, under any circumstances, must be kept in good running order at the central station, and which otherwise would, during the day hours, lie idle.

The Sub-committee on Electrical and Mechanical Devices, of which Henry Morton is chairman, and A. B. Chandler, J. P. Davis, F. H. May, H. W. Pope, G. S. Mott, Elihu Thomson, and J. Elliott Smith are members, met at 115 Broadway to consider a report of the secretary, William C. Behrens. Of the 400 patents examined, special attention was given to those relating to means for removing the disturbing influence of induction, and the most important of these were reserved for more extended and careful consideration. It was resolved, in order to stimulate and assist inventors, that an additional circular letter be issued setting forth specifically the requirements of an inclusive system of underground communication. Secretary Behrens reported that the committee's circular had been printed in three languages, and sent to every scientific and technical school, all great engineering firms and inventors, scientific societies, etc., throughout the civilized world.

The meeting of the New York Electrical Society, June 1, was addressed by William Lachlan, electrical engineer of the Light and Force Company, of New York, on the subject of "The Faure Accumulator." He is the gentleman who, in October, 1881, lighted a railway train by electric light for the first time in history. The train was a fast express running between London and Brighton, and it will be remembered the matter created a profound sensation in the scientific world, and was commented on extensively. The masterly manner in which Mr. Lachlan treated his subject evoked hearty applause from those present. He had on exhibition a few cells of the Faure storage battery, to which were attached two small electric incandescent lamps, a small electric motor, and an electric pen, all of which were in operation simultaneously. The lamps gave out a beautiful light of remarkable brilliancy, and the motor generated power sufficient to run a foot lathe or sewing machine. At the conclusion of Mr. Lachlan's remarks, C. O. Mailloux suggested that perhaps Mr. Lachlan could enlighten the members of the Society on the subject of the actions and reactions which take place in the cells of a storage battery, as nothing positive on the subject has yet been determined. John M. Pendleton, N. S. Keith, C. O. Mailloux and L. L. Leggett each made some remarks upon this important subject. Eight members were elected at this meeting, and the prosperity of the Society is very satisfactory.

TELEPHONE MEETINGS.—At the annual meeting of the Bay State and Boston and Northern Telephone Companies, a large number of stockholders were present, including Thomas A. Sherwin, general auditor of the American Bell Telephone Company, of Boston; Morris F. Tyler, president of the Southern New England Telephone Company; D. B. Varney, president of the Granite State Company, and others. It is probable that a meeting will be held soon to consider definitely the consolidation of these two companies under the name of the New England Telephone Company.

The annual meeting of the Bay State Telephone Company was presided over by President W. A. Ingham. Officers were elected as follows: president, W. A. Ingham; treasurer and clerk, Charles J. Glidden; general manager, Loren N. Downs; directors, W. A. Ingham, Charles

J. Glidden, L. N. Downs, Charles A. Nichols, S. Herbert Howe, Theodore N. Vail, Francis Jewett. The report of the treasurer showed that during the eight months' existence of the company 1,086 subscribers had been added, making the whole number connected May 1, 1883, 2,525. The ex-territorial business has nearly doubled, there being transmitted in April last 8,360 messages. The total net earnings for the eight months were $30,695.63, of which amount $23,800 has been paid out in dividends, leaving a balance of $6,895.63.

There were 4,003 shares represented at the meeting of the Boston & Northern Company. Among those present were W. A. Ingham, M. G. Parker, Charles J. Glidden, Loren N. Downs, William H. Anderson, Freeman B. Shedd, Theodore N. Vail, O. E. Madden, Morris F. Tyler, M. G. Parker. The treasurer's report showed that the total number of subscribers connected May 1, 1883, was 3,160. Eight thousand ex-territorial messages were transmitted in May, 1882, and 12,308 during April, 1883. The net earnings for the year amounted to $69,239.03. Of this amount, $50,700 has been paid out in dividends, leaving a balance of $18,539.03.

Loren N. Downs, general manager of the Southwestern Telephone Company, has ordered from the American Spiral Telephone Company 69 miles of its new wire, and if found better than the ordinary telephone wire, will order 250 additional miles.

THE THOMSON - HOUSTON ELECTRIC LIGHTING SYSTEM.—The present capital of this company is $125,000, and its officers are as follows:

President, Henry A. Pevear.
Vice-president, C. A. Coffin.
Treasurer, S. A. Barton.
Secretary, J. J. Skinner.
Electrician, Elihu Thomson.
Directors, H. A. Pevear, C. A. Coffin, J. N. Smith, Elihu Thomson, S. A. Barton, B. F. Spinney.

In 1877 a committee of the Franklin Institute, of Pennsylvania, consisting of ten competent and eminent experts, with a view of determining the capabilities of electrical generators, made a series of trials with the best machines then procurable. The greater part of the work of the committee, and all relating to electrical measurements, fell to the lot of Elihu Thomson and Edwin J. Houston, then occupying the chairs of chemistry and natural philosophy at the Central High School, Philadelphia. Possessing a thorough knowledge of the principles of electrical science, gained by the study and experience of years, Professors Thomson and Houston were able to devise and perfect a complete system of dynamos, lamps and regulators, perhaps unequaled in value for the purposes of arc lighting. Their early patents bear dates of September 2, October 7, and October 14, 1879; January 13 and January 20, 1880, and cover the essential features which make their machinery unique and reliable. Drawing upon the Gramme inventions for the fundamental principles of their dynamos, their company has united with the syndicate forming the Gramme combination, and is rapidly working to the front as among its strongest factors. The Thomson spherical generator, as it is called from the nearly spherical form of its armature, differs radically from all others in several essential points, viz., its field magnets, armature, winding and commutator. In addition, it is provided with an automatic regulator, an attachment not applied to any other form of generator for arc lighting now in common use. The lamp, which contributes by its regularity of action so much to the efficiency of this system, consists outwardly of a graceful iron frame having curved sides and a small case for regulating mechanism.

The outlook for the Thomson-Houston Electric Company's system is most encouraging. It is but a few months since the first plant was started, and the favor which the light has secured is indicated by the fact that systems are in successful operation at Boston, Lynn, Lowell, Worcester, Fall River and Providence, that they are rapidly multiplying in the West, and that New York is about to witness the formation of a large company. The principal manufactory is located at New Britain, Conn., but foundations are now being laid for a factory in Lynn which will cover nearly an acre of ground and will be devoted to the production of all machinery used in the system. Professor Thomson has protected his inventions by patents in England, France, Germany, Belgium and Canada.

Public Service Commissions

CALIFORNIA.

The Southern California Edison Company has been granted a certificate of public convenience and necessity to construct an electric distribution system in Beaumont.

A decision was rendered granting the application of the Southern California Edison Company to purchase the electric distribution system of the Pacific Electric Company, in Gardena, Moneta, Clifton and Redondo Beach for $17,500.

A decision was rendered granting authority to the California-Oregon Power Company to buy the electric light and power plant of George H. Johnson, at Sisson, for $15,000, and the electric light plant of R. E. Cavanaugh at Edgewood, Siskiyou County, for $10,000.

NEW JERSEY.

The Board of Public Utility Commissioners has refused the application of the Monmouth Lighting Company for permission to transfer an aggregate block of stock of the par value of $16,000 to the Eastern Utilities Corporation, in return for stock of that corporation, holding that to grant the permission would be a violation of the recently enacted corporation acts of the State.

OHIO.

The Public Service Commission has given permission to the Wildwood Service Company to issue its common capital stock of the par value of $30,000 and first-mortgage, 20-year, six-per-cent bonds of the face value of $30,000, both to be sold for not less than 80 per cent of par. The proceeds are to be used for the purchase of real estate and the construction of a combined plant for furnishing electric energy, water and heat.

The Canton Electric Company has been authorized to issue its first and refunding mortgage five-per-cent bonds to the amount of $146,000, to be sold for not less than 85, the proceeds to be used for the reimbursement of income account and for moneys used in recent construction and extension work.

OKLAHOMA.

In connection with the application of C. E. Devin, owner of the telephone exchange at Apache, to the Oklahoma Corporation Commission, asking permission to raise telephone rates, the Commission denied the application, ad-

justed some discriminations which were alleged to exist, and fixed what it considers a reasonable rate.

WISCONSIN.

The decision of the Railroad Commission ordering the Milwaukee Electric Railway and Light Company to furnish 13 fares for 50 cents has been held to be legal and reasonable, according to a recent decision of the Supreme Court. The case was appealed by the company on the ground that the company's franchise constituted a contract in which the fares to be charged were fixed and that any attempt by the Commission to reduce the fares interfered with a binding contract and was therefore unconstitutional. After reviewing the facts in the case, the court was of the opinion that nothing in the statutes empowers municipal authorities to make a contract with a street-railway company fixing rates of fare so that they may not be changed by the Legislature, or through a duly appointed legislative agency acting in a manner provided by law. The decision will have an important bearing upon other decisions of the Commission which are of a somewhat similar nature.

The Supreme Court has upheld the Commission in its valuation of the Appleton water works and incidently laid down an important ruling regarding the valuation of a public utility. The case was appealed on the ground that, among other things, the Commission had not considered the element of going value in arriving at the price which the city of Appleton should pay for the property of the Appleton Water Works Company. The claim that the going value of the plant had not been taken into consideration by the Commission was denied by the court for the reason that the Commission, in arriving at the estimate, had considered the following facts: the elaborate estimates of the engineers not only as to the cost of the reproduction of the plant and its present value based on present prices, but also based on the average of prices for five years; the testimony given in the rate case showing inadequacy in the present plant to meet reasonable demands of service and the necessity of the immediate expenditure of a considerable sum to make the plant reasonably efficient; tabulated statements furnished by the company itself in the rate case which tended to show that the revenues of the plant had not been sufficient at any time to give anything more than an insignificant return upon the investment; complete information as to the condition of the physical property; the attitude of the public toward the concern; and probable growth of the city.

The application of the Ettrick Telephone Company, operating exchanges in Galesville and Ettrick, for a physical connection with the toll lines of the La Crosse Telephone Company, has been granted by the Commission. The testimony showed that the petitioner had, at present, no means of communication with the city of La Crosse and vicinity, although the Western Wisconsin Telephone Company, a competitor of the petitioner in the same district, enjoys the benefits of a physical connection with the La Crosse company's lines. The order requires that the expenses of making the connection be shared equally by the two utilities and that in case of failure to decide upon a reasonable schedule of rates or the division of the same that the matter be submitted to the Commission for adjustment.

Among the Supply Men

LEASING ELECTRICAL EQUIPMENT.

By G. D. Crain, Jr.

The enormous increase in the use of electricity everywhere, and correspondingly large quantity of equipment purchased and used, carries with it the implication of the re-sale of much used equipment, for various reasons, and the consequent availability of many motors, fans, dynamos, and so forth for use by second and third owners. And, inasmuch as much of this equipment comes into the hands of dealers in new equipment, by way of trade, with credit on new goods, it is very likely that out of the accumulation of second-hand goods has grown the practice of renting for short terms various pieces of equipment to those who for any reason do not desire to purchase them.

At any rate, it is a fact that in nearly every city of any size there can be found at least one establishment where almost anything in the way of electrical accessories can be had for any period desired, from a few days to as many months, or even longer, at a reasonable rate; and the extent to which this is done is in itself fair proof that it is profitable to both parties.

"Yes, that's our ad," said a well known electrical contractor and dealer in supplies, referring to a blotter announcing that the firm rented fans and motors. "And we have lots of stuff out, too. But there's no limit to the extent we are willing to go in that direction. Anything we have in stock is for rent, at a reasonable price. We've been in that department of the business for something like three years, and on the whole it is pretty profitable.

"Of course, wherever possible we send out used goods on these lease arrangements, especially where there is any reason whatever to doubt the responsibility of the party using them; and we have a sufficient number of used motors, in particular, running as large as 30 horsepower, to supply most of the demand. If we have nothing second-hand to fill a request for an article for rent, however, we simply take it out of stock.

"Yes, that in effect makes it second-hand; but a short period of service doesn't harm a motor, for instance, in the least. Factory tests themselves constitute use, but they are not considered as converting a motor just made into a second-hand piece of goods; and, in the same way, a motor which has been out on lease for a month or so is practically as good as new, and we can sell it as such. If it is damaged, that is another question. The lessee is expected to make good any injury which makes the motor, or whatever the article leased, less valuable, and in the isolated cases where this occurs we are usually able to see that this is done."

Temporary users of electric equipment of any sort are not, as some dealers in such goods hastily conclude, confined to those who are financially

unable to purchase such equipment. In fact, while there are some who rent for this reason, there are probably many more who know that their requirements are temporary only, and hence do not care to invest in apparatus which will not be needed more than a month or so.

For instance, a contractor taking a construction job in a city distant from his office frequently finds that he needs a motor, or possibly several, for a special use in connection with that particular job. He may have just such motors in use somewhere else; or he may have none. In either event, considering the fact that he will need the equipment only for a short time, he prefers leasing what he needs, even at a comparatively high cost, for the month or two which the job will take, rather than invest a much larger sum in the purchase of machinery which he may not need again, and which will have to be moved after the job is over.

Probably the largest and best class of trade in this particular corner of the field—that is, the leasing business—is of just this sort; for this use not only calls for motors of relatively large size, but payment is pretty certain, both of which points are well worth considering.

Even contractors who have their own electrical equipment, in the handling of jobs right at their home offices, occasionally find themselves in need of several motors on a job a little larger than usual, or where they are running several jobs at once, and all of them call for the use of electrical power. In such a case, inasmuch as their equipment is adjusted to meet their ordinary needs, it would be poor economy to buy a duplicate set for only occasional use; and the situation is well met by renting what is needed, for just as long as it is needed.

A case of this sort was that which occurred in a Middle Western city not long ago, where one of the local contractors, who was pretty well supplied with all kinds of equipment, including his own motors and lighting sets, found himself with several big jobs on his hands at once, two of which especially made necessary, or at least advisable, the use of motor drive in several places. On one of these jobs it was necessary to keep two separate cofferdams dry, and this could be best accomplished by the use of motor-driven pumps. At another place on one of the jobs, a large motor was required for several weeks for the purpose of operating the air-compressor which furnished power to a battery of drills.

As all of the electric power equipment of the contractor was already busy on one of the other jobs, he bethought him at once of a supply firm which made a specialty of leasing equipment; and he found this firm able to supply him with the three motors of the exact sizes he wanted, by a real stroke of fortune, as it was not often that that many of the larger size were free for use at the same time.

Another instance of the sort of demand which has to be filled in some way by temporary service (which, it may be remarked, should be and is charged for accordingly) was at the automobile show held in the city referred to during the winter. With electricity becoming more and more indispensable to the automobile, it was a foregone conclusion that a large amount of equipment of this nature would be required for use during the show; and the leasing firm accordingly looked into the situation and prepared to meet the demand.

Not only were many motors used, being required in the operation of self-starters, air-compressors, searchlights and other accessories of the modern self-propelled vehicle, but the firm also leased several hundred large-size tungsten lamps, which were used to make the big building in which the show was held as bright as day at all times. These bulbs are in a somewhat different class from ordinary electrical equipment, being a good deal more delicate than motors; and of course the charge was adjusted accordingly, besides full compensation being asked for all broken bulbs.

There are frequent instances of small business concerns, usually manufacturing on a small scale, which find the use of electrical power practically indispensable, but which have not the capital necessary to buy motors at the start, in view of other heavy initial expenses. Such concerns as this find the possibility of leasing such motors as they require a very present help, and, moreover, may be classed as ultimate purchasers, if the business prospers. If it does not, the lessor of the goods should be on the lookout for signs of weakening, and keep an eye out for his motors and his rent.

A small knitting establishment in one large city leased from the dealer handling this sort of business five motors when it started up, the five aggregating 25 horsepower. The backers of the business, who were themselves operatives, had strained their credit and their finances to the utmost in the purchase of the necessary knitting machinery, and did not feel like buying motors until they were better established; in fact, they could not have paid for them. The monthly charges were not high, being based, according to the custom which prevails pretty generally, upon the Gregory list, which is widely distributed and serves as a sort of standard for determining leasing charges.

The concern in question prospered, and met its monthly bills promptly; and not long ago the men who owned it went to the dealer who leased them the motors, and obtaining his lowest price on them, paid down the money at once, thus proving the point indicated above—that renters not infrequently develop into purchasers. And during the course of development, they are furnishing the dealer substantial interest on his investment and profit as well.

The charges made are by no means inelastic, however, although, as indicated, the Gregory list is used as a base in the cities in which the instances given occurred. Most dealers who handle this business very shrewdly reckon that they are entitled to charge for the use of the motors just about what that use is worth to the man who wants them.

"For instance," said one, "if a man comes in here whom I can size up as one who has simply got to have a motor, for some emergency use, I charge him accordingly; not a hold-up, you understand, but a price based upon its value to him, and within reaching distance of the standard established by the list. Ordinarily, of course, prices are fairly level, for motors, fans, and everything else I put out. Fans are good money-makers, because there are plenty of office men who would rather pay me almost the price of a fan for use during the warm months, and then have me take it away, than be bothered by having one of their own standing around in the way all winter. That makes pretty good business for me, obviously."

Prices should, of course, be based not only upon the cost of the article, but upon the depreciation which it suffers while in use, as well as upon the risk taken by the dealer, which includes the risk of not getting his money for the rental charge, as well as that of losing the article itself. This last is by no means imaginary, as the dealer quoted found to his cost in a case where he had leased a 20-horsepower motor to a party who subsequently proved to be entirely irresponsible.

The lessor found at the end of three months' use of the motor that he was going to have trouble getting his rent, and called for the money or the motor, with the private intention of taking both if he could. He discovered, however, that he could get neither without a fight; and at the end of a lawsuit he considered himself lucky to

recover his motor, with the rent a total loss and the cost of the litigation and the wear and tear on the motor and his temper to be charged up to experience.

The possibility of this sort of thing points to the desirability of making it a uniform rule that rent for equipment leased shall be paid in advance. This rule can usually be enforced, and a strict adherence to it will save a good deal of trouble with people who are in the habit of getting and remaining behind with all bills.

For a concern which has any quantity of used electrical goods on its hands, very little additional investment is required in order to be prepared to meet any ordinary demand for equipment for temporary use; and even where additional purchases are necessary, the profit earned out of charges properly fixed with reference to the considerations indicated above will pay big interest on this investment.

B. B. Downs, president of the St. Paul Electric Company, St. Paul, Minn., has just returned from an eastern trip where he visited several factories his company represents. Mr. Downs reports business in a very healthy condition, and future prospects bright.

J. M. Hannaford, of the Northwestern Electric Equipment Company, St. Paul, Minn., states that his company is carrying on a summer campaign on electric appliances for the home. His company is also conducting a special prize window competition among the dealers in electrical goods, particularly those which are regularly carried by the company. The June issue of the *Northwestern Buzzer*, published by the company, is full of good information respecting the lines the company handles.

G. H. Pettibone, manager of the Modern Electric Company, Burlington, Iowa, reports that business is moving along very nicely. Mr. Pettibone has just been on the Burlington Boosters' Excursion over southern Iowa and northern Missouri. There were 75 leading manufacturers and jobbers included in the personnel of the excursion.

C. W. Teas & Company have been incorporated in Chattanooga, Tenn., to deal in electrical supplies. The concern has $10,000 capital stock. W. C. Teas, John Smith and others are incorporators.

The Union Electric Company, Pittsburgh, Pa., has ready for distribution a new 56-page discount sheet applying to its No. 6 electrical supply catalog.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 140.—Electrical Equipment of Gasoline Automobiles.—Which type of electrical equipment is better for gasoline automobiles, to have the electric starting, lighting and ignition combined in one system, or to have a separate outfit for each purpose? What are the advantages of each plan?—C. B. W., St. Joseph, Mich.

No. 142.—Allowance for Reduced Maximum Demand in Summer.—Recently I read an article explaining a rate system used by a British central station in which the number of hours charged for at the primary rate was less in summer than in winter, so as to compensate for the reduced maximum demand and decreased lighting load in summer and to encourage the use of electricity for cooking. Is this system in use anywhere in this country?—F. D., Racine, Wis.

No. 145.—Interference of Power and Telephone Lines.—It has always been stated that by careful transposition of telephone lines inductive disturbances to them from any other adjoining overhead circuits is prevented. In California much difficulty has been experienced by telephone companies from the neighboring lines of power companies. Is this due to improper transposition or is ordinary transposition ineffective against induction from high-tension lines?—W. M. S., Ogden, Utah.

No. 146.—Ozonator for Direct-Current Circuits.—Are any ozonators built for use on direct-current circuits or is it necessary to connect them to the alternating-current side of a motor-generator or inverted rotary converter?—B. J. L., Cleveland, O.

No. 147.—High-Frequency and High-Tension Tests.—(1) What is the highest frequency ever known? (2) In what year did Nikola Tesla conduct his high-tension tests in Colorado and what were the results? (3) What kind of machines were used?—A. M. E., West Medford, Mass.

No. 148.—Armature Band Wires.—What difference will it make in the action of a direct-current armature to use iron or steel wire or brass or bronze wire for banding? Would the iron wire have a tendency to shunt some of the magnetic flux from one pole to the other and thereby weaken the field?—F. E. K., Highland Park, Mich.

No. 149.—Why Do These Wattmeters Not Read Correctly?—We have in this plant two belted three-phase generators and a turbogenerator; any two or all can be synchronized. When the turbo unit is operating alone its wattmeter runs backward, but when in parallel with either belted unit the meters run forward, the indicating meter showing a large wattage at light load and the recording meter running fast; but under heavy load the indicating meter shows low wattage and the recording meter runs slow. The belted machines are rated at 75 and 150 kilowatts and the turbo machine at 100 kilowatts.—S. R. R., Macomb, Ill.

Answers.

No. 138.—Electric Fly and Rat Traps.—Can a voltage less than 110 be used successfully in electric fly traps? What is the best voltage for electrocuting rats and mice?—M. A., Johnstown, Pa.

Since the above question was published the writer has made some experiments in electrocuting rats and mice, using various voltages and frequencies, also direct current. The trap used was similar to the one described by R. W. A. in the issue of May 10. A rat was killed by 220 volts direct current and several were not; 110 volts direct current and alternating current failed to have any permanent effect; 220, 440 and 2,200 volts alternating current (25 cycles) killed the rats every time; also 550 volts direct current frequently was fatal. Mice were killed on lower voltages than rats; 110 volts, 25 cycles, 110 volts 60 cycles, and 220 volts 60 cycles were successfully used. On 550-volt direct current a mouse was carbonized and produced a short-circuit on the line. The rats (31 in number) experimented with were obtained from a livery stable and kept in cages until ready to turn into the trap. I found that the old rats could stand a higher voltage than the younger ones. One old fellow succeeded in getting by everything but 2,200 volts 25 cycles, while three younger ones were killed by 220 volts. From these experiments it would seem that the age and constitution of the rat determined the voltage necessary to electrocute it. No difference was noticed between the male and female and no voltage lower than 220 at 25 cycles was successful with every rodent. Such traps for general use would probably be more dangerous than beneficial and doubtless would not be permitted by the underwriters.—F. H. P., Indianapolis, Ind.

No. 144.—Questions on Approved Wiring.—(a) Are sign receptacles with contact screws approved to be mounted in cornices for decorative purposes or

should only pig-tail receptacles be used, thus avoiding possible grounding? (b) In grouping cables behind switchboards must each conductor have a separate covering of flexible tubing, or is it approved to cover the whole group with one layer of tape? (c) What is the proper size fuse for the neutral of a three-wire, two-phase system? (d) Why do inspectors in different localities make such different rulings, for example in one department No. 8 wire is required to be soldered into lugs, whereas an adjoining department does not require this?—J. G., Newark, N. J.

(a)—I think that the rule which reads "Sockets and receptacles must be of the keyless porcelain type, and wires must be soldered to lugs on same," answers this question. (b)—If the cable referred to is made up of the wires that run between the rheostat and its contact plate and there is not more than 75 volts between any two wires this is approved, but where the difference of potential is 110 volts or over I think flexible tubing is required in most places. (d)—Local inspectors are sometimes prone to set themselves above the National Board and until this body has national authority I do not see what can be done about it. Of course, local conditions change many things and special rules are necessary, but in the question referred to I should think that the rule which reads, "When they have a conductivity greater than that of No. 8 B. & S. gauge, they must be soldered into lugs," would cover this point and would be the same everywhere that the National Electrical Code is applied.—E. W. D., Boston, Mass.

(a)—Sign receptacles with screw terminals are approved in metal cornices for decorative or outline lighting. The National Electrical Code states that: "Sockets and receptacles must be of the keyless porcelain type, and wires must be soldered to lugs on same." The Code is a little hazy on the details of this type of construction and I presume it is intended that the local inspector having jurisdiction shall pass upon each particular case. I have always aimed to have this kind of work done in a sheet-metal trough forming part of the cornice; this trough should be so constructed that the cover or some portion can be easily removed to inspect the wire or make repairs; this trough will then form a raceway for the wires. No part of the trough should be nearer than one-half inch from the terminal lugs on the receptacle and it is good practice to make this a minimum of one inch. The metal should be at least No. 20 gauge and galvanized, and it should be painted on the surfaces that are exposed to the weather. The trough should be weatherproof. Not over 1,320 watts should be on one circuit nor over 24 receptacles. (b)—In grouping cables behind switchboards (I presume this refers to low-potential systems, 550 volts or less), the inspectors seem to approve jumping from a junction box or a condulet fitting to the terminal lugs on the rear of the switchboard and taping the wires together, but the Code states that they "Must be wired with conductors having an insulation as required for molding or conduit work and covered with a substantial flame-proof braid." I am not sure whether a wire that will meet these requirements is manufactured but there is an asbestos tubing on the market that could be slipped over each wire which I think would meet the requirements. The objection to a mass of tape and rubber insulation at the rear of a switchboard is the danger from fire. (c)—The middle or common wire of a three-wire two-phase system is not a neutral, but a common wire, and the current in same is the current in one outside wire times the square root of two, or 1.4. If there were 50 amperes in one outside wire there would be $50 \times 1.4 = 70$ amperes in the common wire. The proper size fuses would, of course, depend upon the size of the load. (d)—The Code states that, "Stranded wires (except in flexible cords) must be soldered before being fastened under clamps or binding screws, and whether stranded or solid, when they have a conductivity greater than that of No. 8 B. & S. gauge, they must be soldered into lugs for all terminal connections, except where an approved solderless terminal connector is used." The variation from this or other rules as set down in the Code may be due to several reasons: the ignorance of the inspector, or he may be a city inspector instead of an underwriters' inspector and frequently the different cities have different rulings. All inspectors have more or less authority to deviate from the rulings and enforce their own interpretations of same; this at times works a hardship upon the contractor or workman.—C. T. P., San Francisco, Cal.

The following is based on the rules of the Boston Wire Department. (a)—In damp or wet places weatherproof sockets or receptacles must be used. Skeleton metal sockets or receptacles are allowed only outside of buildings and only for sign letters or temporary work, in either case special permission must be obtained from Wire Department. (b)—Do not tape for any great distance, say in making a bend or corner, in fact, it is better to run open, making all bends at sharp right angles, giving a good appearance and helping the wires to stay where placed. Recently I ran 155 No. 6 slow-burning wires behind four Cutler-Hammer charging boards, and those wires might just as well have been taped together, so close were they. It might be a good plan to put a piece of circular loom on every other wire. (c)—The current in the middle wire will be 1.414 times the current in the outside wires. The central wire must, therefore, be large enough to answer as the return wire for both the others. In view of this fact, it is wise, perhaps, not to fuse the middle wire at all. (d)—The National Board of Fire Underwriters is pretty nearly a standard authority, but the various city departments have different ideas on the same subject, hence the variations. In Boston, wire of greater conductivity than No. 8 must be soldered into lugs.—W. E. R., Boston, Mass.

Investigation of Federal Building Plants.

An investigation has been undertaken by the Joint Committee on Second-Class Mail Matter of which former Senator Bourne, of Oregon, is chairman, to ascertain the expense of operating isolated power plants in Government buildings.

The Committee, in ascertaining the cost of operating the postal service, will inquire into the question of whether it is cheaper for the Federal Government to own or rent quarters for post offices, and how the care of Government buildings and the supply of power therein can best be accomplished. This subject is of special interest in connection with the fact that Secretary of the Treasury McAdoo let a contract this week to the Harrisburg Foundry & Machine Works for the installation of engines and generators, costing $42,000, in the Federal Building in Chicago, Ill.

The building is now supplied by the Commonwealth Edison Company, and a reduced rate has been offered the Government for renewal of the contract, but the Government engineers have estimated that a saving can be accomplished by the operation of an isolated plant, which will use the exhaust steam from the engines for heating the building.

Examination for Laboratory Assistant.

The United States Civil Service Commission has announced an open competitive examination for laboratory assistant in physics in the Bureau of Standards, Washington, D. C., at salaries from $900 to $1,200 per annum. Appointees will be assigned to work in the subjects for which they are best fitted and separate examination papers are provided for those choosing electricity.

This examination will be held on July 2 at the usual places and applicants should procure Examination Form 1,312.

NATIONAL DISTRICT HEATING ASSOCIATION.

Report of Fifth Annual Convention Held at Indianapolis.

The fifth annual convention of the National District Heating Association was held at the Claypool Hotel, Indianapolis, Ind., on May 27, 28 and 29. In connection with the convention there was an exhibit of apparatus and material by manufacturers and supply houses.

The first session of the convention was called to order at 10:30 a. m., on Tuesday, by President R. D. De Wolf, who introduced Charles A. Bookwalter, former mayor of the city. Mr. Bookwalter delivered an address of welcome, to which Secretary D. L. Gaskill responded.

The first order of business was the election of new members and upon recommendation of the Executive Committee 17 active members and 10 associate members were elected.

President De Wolf then delivered his address, in which he pointed out the value of the Association to its members. Reliable data are needed covering conditions. Losses in transmission need to be carefully studied and economical methods of operation devised. These and similar questions offer many opportunities for valuable work by the committees. Most central-station companies have already taken on the larger part of the small business which is available and loads of this character will in the future be limited by the growth of the community. To increase business at a greater rate it is necessary for central stations to be prepared to furnish heating service as well as power. Rates should be placed upon a logical basis, similar to that in use for electrical energy. Specifications covering heating installations should be more uniform and it would be a great benefit if the Association could interest the architect in the adoption of standard specifications for apparatus, installation and testing. Mr. De Wolf then spoke of the work of the committees which were to report at the meeting, and in closing stated: "District heating is economically right and with the increasing necessity for conserving fuel resources and with the growing demand for smokeless cities, its importance, convenience and economy cannot fail to be recognized."

The report of the secretary-treasurer was then submitted. It showed a cash balance on hand of $320 and a membership in the Association amounting to 168 active and 61 associate members. The printed proceedings of the last convention had been lost in the flood at Dayton, O., where they were being bound, involving a loss to the Association of about $400. These proceedings will be reprinted and will be ready for delivery to the members about September 1, 1913.

The Executive Committee then presented a report in which amendments to the constitution were submitted, to be acted upon at a future session.

The chairman appointed a Nominating Committee, consisting of W. A. Wolls, D. S. Boyden and A. D. Spencer.

The report of the Meter Committee was then presented by S. Morgan Bushnell, chairman.

Report of Steam-Meter Committee.

This report includes descriptions of the Hallwachs, Gebhardt and St. John steam meters; a consideration of the defects of the revolving and dumping types of condensation meters; and a statement of the care desirable in the use of condensation meters and the General Electric meter. Rules are given for the installation and maintenance of Simplex and other condensation meters. The routine of operation in the meter department of the Murphy Power Company is given in some detail. The report then discusses the meter versus the flat-rate system of charging. Flat rates have the advantage of (1) saving in the initial expenditure for meters and installation; (2) saving in operating costs, such as inspection, reading, testing and maintenance of meters; (3) simplification of bookkeeping and billing; and (4) greater ease in making contracts, since customers like to know what the service is going to cost. The disadvantages of the flat-rate system, which in the judgment of the Committee, more than offset the advantages are: (1) it must necessarily be inequitable for a large number of customers since it is based on average consumption; (2) it encourages extravagance on the part of the customer, since there is no incentive to economize; (3) if temperature-controlling devices are used on the premises to guard against extravagance, it is necessary to exercise an inspection and maintenance, which will largely offset the cost for meters. It is quite customary to make meter rates too low. The average cost of 30 steam-heating companies was found to be 48.5 cents per thousand pounds with discounts for larger consumers. Statistics collected in Detroit, Mich., and by the Wisconsin Railroad Commission show that the cost of producing steam varies from 50 to 60 cents per thousand pounds, including operating expenses and fixed charges. This shows why many companies fail to make steam heating pay, even after they adopt meter rates.

The discussion was opened by Eleazer Darrow, Indianapolis, who, with respect to flat and meter rates, spoke of service rendered and peak-load conditions. Charging by meter tends to accumulate the peak on some heating plants, and this comes at about the same hour as the morning peak for electric lighting; that is, between seven and eight in the morning.

H. R. Wetherell, Peoria, Ill., compared conditions for two companies in which he was interested, the first of which uses partly meter rates and partly flat rates, and the second, entirely meter rates. The consumption of steam per square foot of radiation for eight months was for the first company, 784 pounds, and for the second, 610 pounds. A test on the waste of steam showed a greater amount of steam condensed in a radiator in front of an open window with the outside temperature about 40 degrees than with an outside temperature of 10 degrees and the window closed, the consumption being about twice in the former case. Changing one company from flat rate to meter rate increased the revenue 50 per cent and cut the coal bill in half. Some meter customers use as low as 140 pounds per square foot of steam per season; whereas some flat-rate customers use as high as 3,000 pounds.

C. H. Spiehler, Dayton, O., testified to a similar experience.

George E. Quinan, Seattle, Wash., referred to two districts into which that city is divided, the class of the buildings in each being about the same, but one district carries a great deal of flat-rate business while everything is metered in the other. The consumption in the flat-rate district is about one-third higher than in the meter district, and the load-factor is about 63 per cent as compared with 49 per cent for the meter district. This load-factor is based on a one-hour maximum. The meter system is certainly more economical.

Charles R. Bishop, North Tonowanda, N. Y., spoke of the use in connection with the meter of a recording device which registered every time the meter indicated a complete revolution, and thus showed when the customer was using most steam. Another device used in San Francisco is a butterfly valve on the main steam pipe, which is connected with a clock and an electrical contact. This enables steam to be turned off at any given hour and turned on again at a predetermined setting. A slight opening is left in the butterfly valve so that enough steam passes to prevent freezing. He told of one case where a change to meter service showed a saving in operation of 18 per cent and an increase in revenue of nine per cent, with no increase in cost to the customer.

L. T. Mason, Hornell, N. Y., told of a combination electric light and steam-heating plant, which had been run for 14 years and had been losing money from the steam heating, while on a flat-rate basis, in competition with natural gas. Meters were finally adopted, and figures were presented showing a comparison between flat-rate and meter operation. Al-

though the connected load was greater under meter service there was a decrease in the coal used of about 30 per cent.

Eleazer Darrow pointed out that most of the trouble with flat rates was due to waste of steam by the consumer. This could also be obviated by automatic regulation and he considered it the critical thing in a steam heating system. Such regulators are used in Indianapolis and the steam consumption is thus to a large extent controlled by the company. The automatic controller keeps the temperature about 70 degrees without any hand regulation.

D. S. Boyden and H. A. Ruth also joined in the discussion, which was resumed at the afternoon session. Mr. Wetherell, in order to show some customers why their bills were so high, took meter readings twice a day, morning and evening, and in many cases found that more steam was used at night time than during the day.

A. C. Rogers, Toledo, O., had found it preferable to reduce the pressure or cut off some of the radiators rather than to shut the main valve off in a large building.

The report of the Membership Committee was then presented by A. C. Rogers, chairman.

Eleazer Darrow then presented the report of the Educational Committee. This consisted of a basis for a code pertaining to important points in the installation of heating and ventilating plants. Co-operation with the American Society of Heating and Ventilating Engineers, and the American Society of Mechanical Engineers in formulating a code was suggested. The Committee was continued for another year in order to continue this work.

A. C. Rogers then presented a paper entitled "Hot-Water Heating For Residence Districts." In the course of this paper Mr. Rogers presented a number of formulas for computing the radiating surface required in different buildings and this gave rise to considerable discussion as to the basis of such computations, which was participated in by H. A. Woodworth, O. C. Irwin, N. M. Argabrite, Theodore Weinshank, R. D De Wolf, Frank K. Chew and W. A. Wolls.

A paper was then presented by N. M. Argabrite entitled "Possibilities of Hot-Water Heating."

Possibilities of Hot-Water Heating.

The possibilities of hot-water heating for the central station are affected by the way the plant is designed and constructed, the rates charged, the methods used in figuring radiation, the condition of the pipe lines, etc. Four ways of transferring the heat from the exhaust steam to the water are mentioned, of which the best is stated to be the use of an oversized heating condenser with the heating water circulated through the cooling chamber and a dry-vacuum pump and hot-well pump to keep a high vacuum on the prime mover and obtain the condensate for boiler feed. Next in desirability to this is the use of a jet condenser in which the water takes up the exhaust steam. More plants waste money from small minor shortcomings than from the bigger things. Among these are leaky valves, bad packing, poorly covered pipes, inefficient pumps, etc. The relation between the electrical load and the heating load has more effect upon the earning capacity than anything else. A case is mentioned of a central station having less than one customer to every 14 population; whereas it is not unusual nowadays to have one customer for every five of population. Where electric customers use current principally for lighting, hot-water heating has an advantage over steam heating, since it admits to a certain extent of heat storage. The ideal condition for a heating load on an electrical power station is in the larger cities, where several power plants are working in connection, and the load on the heating plant can be adjusted to suit heating requirements. The way in which the books are kept has much to do with the apparent earnings and the proposition as to whether the heating plant represents profit or loss. Most plant managers do not know exactly where they stand in this regard. The conditions of the pipe lines have much to do with the results on a hot-water system, even more than on a steam system. Small leaks cause depreciation in the pipes and also loss at the coal pile. Most possibilities of hot-water and steam heating are in common. The greatest possibilities in making the hot-water heating a money maker are: making the plant condensing and doing away with open heaters; installing thermostatic control for consumers; improving pipe insulation; reducing excessive circulation pressures; eliminating leaky pipes, etc. Detailed calculations are given showing how money can be saved by eliminating unsuitable equipment. Chances of this kind can be followed up in saving the condensate for boiler feed water, circulating the water more slowly, running the heating units condensing, etc.

This was discussed by Thomas Donohue, L. D. West, D. S. Boyden, Theodore Weinshank, Byron T. Gifford, A. C. Rogers, H. A. Woodworth, E. Darrow, Thomas Wilson, G. E. Chapman and O. C. Irwin. It was brought out that in comparing hot water with steam heating the former suffers from the handicap of the pumping loss and there is more coal wasted in driving the pumps than from any other cause. Since electric pumps are the most efficient, it is desirable to do pumping by this means. 25 to 30 horsepower per 100,000 feet of radiating surface is necessary on the average. Better results are obtained with lower pressure, and consequently lower velocity, and water of proper temperature, rather than with lower temperature and higher velocity. The amount of water pumped depends a great deal upon outside temperatures, but the variation is not great, since the amount of heat required is controlled by the temperature of the water. Two pounds differential pressure at the end of the line is satisfactory and operations are sometimes conducted with one pound which will do for an ordinary building. As good results cannot be obtained where there is a mixed system of installation in the buildings as where these are all uniform. The gravity system for instance requires a great deal more water than do others. The water for these should be throttled very closely in order that other customers will get sufficient.

At the opening of the third session on Wednesday morning A. B. Biggs, of Detroit, Mich., presented the report of the Committee on Station Records. This emphasized the need of keeping comprehensive records of all elements of cost together with data on the operation, service conditions, weather and other factors that influence production and use of heating. A map of the heated district should show accurately the entire layout of the heating mains and minimum distributing pressures at various points. The report also includes a summary of the most useful monthly and annual records that should be kept.

The report was discussed by D. S. Boyden of Boston who urged strongly the adoption of a standard and uniform system of accounting for heating utilities so that the costs and incomes of different plants can be compared on the same basis. N. M. Argabrite, of Elwood, Ind., spoke on the great value of keeping complete records. It is usually considered rather costly to keep extensive records, and it is true that it is somewhat hard to start a good system of record keeping, in fact, it is much harder to start this than to keep it up. Experience shows that after the system is once inaugurated it does not involve much work to gather the data from time to time. He explained many features of the data system used by his company, and various ways in which the value of these data have been made manifest.

Norman C. Reinicker, of the Edison Illuminating Company, Detroit, then presented a paper entitled "Recent Improvements in Boiler-Plant Design and Operation." This paper dwelt particularly upon the experience of the Detroit company with the operation of its specially large Stirling boilers at the Delray plant. It emphasized the high economy of these units both as to initial and operating cost. They are provided with stokers at each end and in operation during the day they are run at considerable over their rated capacity, which is 2,365 boiler horsepower. During the night one stoker is banked and the boiler operated at reduced capacity, but the heat

of the boiler setting is retained in this way and starting up under full load is greatly facilitated. The experience has been that the large boilers are more reliable than the turbines with their numerous auxiliaries; moreover boilers are not thrown out of gear as quickly as generators or turbines. The underfeed type of stoker has come into more extensive use for the highly volatile bituminous coals with very excellent results. The use of the large boilers has brought about an increase in efficiency from about 74 to about 80 per cent. A distinct development in the Detroit plant has been the new type of baffling made use of on boilers of about 500 horsepower. In these Stirling units a rearrangement of the baffles has premitted four passes of the hot gases instead of three as heretofore. This has itself raised the boiler efficiency about 2.5 per cent, but its greatest advantage is the practically entire elimination of arches and consequent decrease in repair bills to the brick walls and other elements of the boiler setting.

The reading of this paper was followed by a large number of questions to which Mr. Reinicker replied. Among those participating were N. M. Argabrite, L. D. West, O. C. Irwin and C. H. Spiehler. A written discussion submitted by J. S. Jacobus, of the Babcock & Wilcox Company, was read by Secretary Gaskill. In this Dr. Jacobus called particular attention to the thoroughness and great care of the tests conducted at Detroit on the large boilers. Similar tests are now being made by the Cleveland Illuminating Company and it is believed that they will also bear out the high economy of large units. It is extremely important to have the best boiler-room management attainable; of course, it is necessary to have good boiler and stoker equipment with recording instruments as auxiliary means for attaining efficient results, but this is not enough; it is also necessary to have trained supervision and skilled operatives in order to get the most out of the equipment.

Bleeder Turbines.

The subject of bleeder turbines was then brought up by President De Wolf who sought a general discussion on this topic. N. M. Argabrite spoke of some results attained with this type of machine in Atlantic City. Mr. De Wolf described the installation of bleeder type turbines that is being placed in the plant of the Rochester Railway & Light Company. These machines are arranged to bleed from the first stage. The pressure at which the steam is bled varies according to the electrical load on the generator and it will be necessary to install a pressure-reducing valve so that the steam delivered to the heating system will be at practically constant pressure. N. C. Reinicker described an installation in Detroit in which bleeder type turbines were installed giving steam from the second stage for boiler-feed purposes.

Election of Officers.

The next order of business was the election of officers for the ensuing year. On motion the report of the Nominating Committee submitted on the preceding day was approved and by unanimous ballot the election resulted in the choice of the following:

President, S. Morgan Bushnell, of the Illinois Maintenance Company, Chicago, Ill.

First Vice-president, E. Darrow, Indianapolis, Ind.

Second Vice-president, H. R. Wetherell, Peoria, Ill.

Third Vice-president, D. S. Boyden, Boston, Mass.

Secretary-Treasurer, D. L. Gaskill, Greenville, O.

Executive Committee, C. F. Oehlmann, Denver, Colo.; W. A. Wolls, Columbus, O.; R. D. De Wolf, Rochester, N. Y.

Mr. Bushnell was called upon and made a brief address, thanking the members and calling attention to the importance of the work of the Association.

The next subject brought up was action on the proposed amendments to the constitution that had been presented on the preceding day. The first amendment respecting a new classification of members was unanimously adopted after some discussion. It provides for three classes of active membership and for one class each of associate and honorary members. Class A active members are companies and individuals engaged in operating district heating plants, also consulting engineers not engaged in manufacture of apparatus; class B active members are officers and employees of the class A companies, firms or individuals; class C active members may be local heating contractors and others interested in district heating but not in the manufacture of equipment therefor. Associate members are manufacturers of heating apparatus and supplies, also national contractors and trade journals. Honorary members must be persons of distinguished merit in the heating field. After a spirited discussion the second amendment respecting dues was adopted, after deciding to make the dues of all class A members alike ($10 per year) regardless of the size of the community they did business in; dues of class B and class C members are $5 a year; of associate members $10 a year.

The question of replenishing the funds of the Association for the additional expense involved in republishing its 1912 proceedings was brought up and a movement led by Charles R. Bishop, of the American District Steam Company, brought about the voluntary contribution of generous sums from both associate and active members for the relief of the situation.

On Wednesday afternoon the fourth session of the convention opened with a talk by H. W. Prentis, Jr., of the Armstrong Cork Company, Pittsburgh, Pa., his subject being "The Insulation of Underground Steam Lines." With the aid of numerous lantern slides Mr. Prentis gave a brief but interesting dissertation on the use of cork insulation. In the discussion of this subject, in which Theodore Weinshank, Thomas Donohue and N. W. Argabrite participated, the question came up of how to make an underground pipe line waterproof. The opinion seemed to be that it was substantially impossible to do this except at almost prohibitive expense.

District Heating on Pacific Coast.

G. E. Quinan, of the Puget Sound Light & Power Company, Seattle, Wash., gave an extemporaneous but very interesting talk on "District Heating on the Pacific Coast." He described particularly the heating system in Seattle which is fed from two plants supplying live steam to the business section of the city, comprising an extent of about 17 blocks in length and 5 to 6 in width. Mr. Quinan described the weather conditions and other local peculiarities, the method of operation, the rates prevailing (which are practically all on the meter system), the design of the heating plant and distributing system and other features of interest. About 500,000 square feet of radiation is connected with the system, which has 535 consumers. The company also supplies electric power from water-power plants and for this reason live steam is used for the heating service. It has been found that the supply of heat is a very satisfactory way to keep out isolated plants, of which are practically none in Seattle. At the conclusion of his talk Mr. Quinan replied to many questions regarding details of the installation and method of operation of the Seattle plant. Among those who discussed the subject briefly were J. H. Walker, L. D. West, Thomas Donohue, Charles R. Bishop, President De Wolf and R. C. Marsh.

Harold Almert, of H. M. Byllesby

& Company, Chicago, Ill., then presented a paper entitled "Appraisal of Heating Properties."

Valution of Utility Properties.

Mr. Almert first discussed the tendency toward regulation of public utilities and pointed out the difference of opinion held in different parts of the country on details of regulation. Many of the public service commissions are extremely fair and are a boon both to the public and to the untilities, but some commissions have not been so fortunately constituted or else have been hampered by immature legislation so that the decisions rendered by these commissions cannot be regarded as models. There is still considerable difference of opinion regarding rate making, although it is coming to be more generally accepted that a proper valuation of the entire property, both tangible and intangible, is necessary. On account of different conditions prevailing in different parts of the country, different bases of valuation have come into vogue. All require, however, an appraisal of the assets of the utility. The mere valuation of the physical property is a simple task but a complete appraisal of every item, both physical and intangible, which should be considered in making up the value on which the utility is entitled to earn a fair return, is a much more difficult matter, calling for experience and training, both technical and commercial. In making such an appraisal it is best to engage the service of some competent outside corps of appraisal engineers or valuators. Values determined in this manner are looked upon more favorably by regulating boards than any value determined by the engineers of the utility itself. One of the most difficult elements to appraise is what is known as going value. It is highly desirable for any utility company to find out in detail the exact investment which it has for any given class of consumers, the exact cost of serving them, the revenue received and, after deducting all proper charges for operation, taxes, maintenance, depreciation, etc., to find out whether or not sufficient is left over to pay a reasonable return on this investment. Then a careful analysis may show surprising results; a class of business that was regarded as most profitable may be shown to be far from profitable. It may show the possibility of reducing rates to another class of customers that is evidently carrying a larger share of the burden than is just and this may be the means of greatly increasing the number of that class of customers. Comparatively few companies have the facilities, time or talent within their own organization to make such analysis quickly and correctly; therefore it is desirable to engage the services of organizations trained for this work.

At the session on Thursday morning the first paper presented was by D. L. Gaskill, secretary of the Ohio Electric Light Association, on the subject "Commission Control of Public Utilities." In this paper Mr. Gaskill pointed out the need for commission regulation and considered the necessary requirements in order that it should be satisfactory. Such a body must have power to grant relief to the injured party and to enforce its mandates. It should have ample means for carrying on this work. Where state commissioners have proper powers and ample funds the results have been highly satisfactory to the people, but where local municipalities have regulatory powers the results have generally been unsatisfactory.

This paper was discussed by D. S. Boyden, E. B. Tyler, Frank K. Chew, R. C. Marsh, Harold Almert and Thomas Donohue.

The next paper, by C. J. Davidson, entitled "Is District Heating Profitable to the Central Station?" was, in the absence of the author, read by the secretary.

Is District Heating Profitable to the Central Station?

This paper points out the divergence of opinion between customer and heating companies as to the profits in district heating and aims to analyze the causes. The writer considers those elements of the problem which determine the advisability of supplying steam from a central station. The greatest reason for failure is an attempt to sell steam on a flat rate. Hot-water heating is not considered and is not regarded as so advisable because any customer can supply himself when necessary, and there is thus potential competition. Most prospects are equipped for steam and it is easier to change from water to steam than from steam to water. Moreover, steam can be metered, while the heat in water cannot. Hotels and restaurants are not desirable customers, since they need high-pressure steam. This service, if supplied at all, should certainly be metered. An important factor is the location of the central station with reference to the load. Long transmission does not pay. The character of the electric load must be considered as well as the type of prime mover in use. High-pressure turbines do not lend themselves so easily to the problem as compound condensing engines or bleeder-type turbines. If the electric supply is for lighting only, the condition is not a favorable one, but if the supply of exhaust steam fits in fairly well with the demands for heating, the condition is favorable. For a new installation careful consideration should be given to the selection of apparatus and type of engine best adapted to the conditions. The writer prefers the use of cast iron for street mains to either wrought iron or steel. Pipes should be properly insulated and laid in concrete.

This paper was discussed by R. C. Marsh, H. R. Wetherell and D. K. Mason. Mr. Mason stated that there was no difference between steel and iron pipe with respect to corrosion. Mr. Wetherell had used cast-iron pipe with entire satisfaction.

Heating of Factory Buildings.

Edward L. Wilder, Rochester, N. Y., then presented a paper entitled "Operating Economies in Heating Large Factory Buildings." Mr. Wilder cited two cases of large buildings using steam heat where economies had been introduced by shutting off steam for certain periods at night. It is well worth while for a heating company to show customers how to use steam economically and get the most service for the money they pay. With steam shut off there is less heating loss from the building because less circulation of air and because of the lower difference in temperature between inside and outside of the building. Moreover, with heat left on at night the temperature is likely to rise higher than during the day and windows are opened in the morning to lower the temperature. Recording theremometers had been found very useful in studying operation. Charts were given illustrating the temperature record in the two buildings mentioned and the schedules adopted were given in detail. Savings of 37 and 32 per cent were accomplished in these two cases.

This paper was discussed by H. R. Wetherell, Theodore Weinshank, H. A. Ruth, D. S. Boyden, O. H. Bathgate and R. D. De Wolf, the principal point in controversy being as to whether intermittent or continuous heating was most economical. Mr. Weinshank's experience had been that more steam was required to heat a building intermittently than continuously. Mr. Boyden had found it to depend upon the outside temperature. With the outside temperature below 30 degrees he had found continuous heating more economical as well as more satisfactory in service. Mr. Ruth and Mr. Wilder had found it more economical to shut down the steam during the night. Unless heating during the night hours is carefully watched there is likely to be great waste. Mr De Wolf pointed out that buildings are often overheated, which results in decreasing the efficiency of the operatives, and the output of the factory is less than when the temperature is maintained at a more healthy point. The efficiency of a manufacturing plant is directly affected by the proper handling of the heating.

After a discussion of the best methods of promoting the work of the Association the convention adjourned.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.

Ninth Annual Convention at Galveston, Tex.

This association, having in former years made itself unique because of its large attendance, this year as a further advance adopted the plan of holding parallel sessions, which proved a great success and which will no doubt be a feature of future conventions.

The opening session on Wednesday morning, May 21, was called to order in the Ball Room of the Hotel Galvez, Galveston, Tex., at eleven o'clock by the president of the Association, Fred M. Lege, Jr., of Galveston. J. H. Kauffman, secretary of the Commercial Club of Galveston, in a very cordial address welcomed the delegates to Galveston. W. B. Head, of Dallas, on behalf of the Association, responded. President Lege then read his address in which he stated in part as follows:

There is, I believe, an awakening among the utilities of Texas to the benefits to be derived from full cooperation and they are also realizing that in this association lies the great and present opportunity for that cooperation.

We all know that a change has been taking place in the relation between ourselves and our public. The storm of denunciation and misrepresentation let loose on us the past few years has had good results in that it has cleared the air for better vision by both our public and ourselves. We have both learned that there are two sides to the matter, and, what is better, we have each learned to go around and take a good understanding look at the other side, with mutual benefit. With proper publicity on our part has come better confidence and more encouragement on the part of the public, and that confidence and that encouragement have stirred us to new efforts to merit more.

The future of the public-utility business looks brighter today than ever before and that brighter prospect is caused by a belief that its stability as an investment will be greater in the future than it ever has been in the past, and stability is the very life of investment, as it is the death of speculation.

The convention then resolved itself into two separate sessions, the street-railway men and electrical men remaining in the Ball Room and the gas men adjourning to an adjoining room where they took up for the remainder of the morning session and all Wednesday afternoon session, problems of respective interest to them.

Thursday Morning Session.

The first paper to be presented at this session was by E. E. Nelson of the Northern Traction Company, Fort Worth, Tex., on the subject of "Erection and Protection of High-Tension Lines and Apparatus."

The author discussed the various elements of equipment in a high-tension plant and the methods of installing and protecting them. The design of the power plant, the arrangement of cables and switchboards, the grounding of metal work and the choice of circuit-breakers were taken up in detail. The various types of protective relays were discussed and the use of air-break switches outside the power house was advocated, in addition to the oil switches within. The various kinds of lightning arresters were described and a choice of these discussed. The multiple-gap, horn-gap, electrolytic and compression-chamber arresters were considered in turn, and care in making proper ground connections emphasized. The choice of line insulators was discussed, the pin and suspension types being considered in detail and the use of arcing rings mentioned.

The discussion was opened by George Cushman, of San Antonio, who cited some early-day experiences with high-tension lines. He also inquired about the danger to the men working on the high-tension lines, to which Mr. Nelson replied that he did not think either on the part of the men or upon the part of the citizens of a town that the high-tension line was any more dangerous than the arc circuits.

H. S. Cooper, the secretary of the Association, stated that in the discussion of that matter a number of years ago it was contended that the higher the tension the safer it was, not only on account of the fact that they took more pains in putting it up, but from the fact that the high tension nearly always went to ground, the high tension jumping over any short break in the ground connection, whereas the low tension would not.

W. L. Wood, Jr., of Texarkana, started considerable discussion by stating that the switchboards some of the manufacturers sent out to medium-sized plants were a mess of junk, that with the field rheostat, generator switch, potential transformers, current transformers and other things on the back of a sixteen or eighteen-inch panel, there was not sufficient space to avoid short-circuiting.

From an insurance standpoint, H. Jalonick, of Dallas, stated that the objection to running high-tension wires through cities was not along the line of its equivalent in an arc-lighting circuit, but that they considered an arc-lighting circuit, or any local circuit, could be shut off in case of fire, whereas in order to cut off a transmission line it would interfere with the lighting of possibly four or five other towns.

A. C. Scott, of the Scott Engineering Company, Dallas, stated in regard to switchboards that he had seen a good many of them in the last few years and thought too much could not be said in regard to the proper care of the switchboard for a small station. One of the most serious defects he had noticed was the placing of the switchboards so close to the wall that after the installation there was no chance for a workman to do anything behind the board. He said: "I think that the manager of a small plant ought to realize that rather than put a board less than five or six feet from a wall that he would better build a larger building or find some space where they could connect the wires as they should be and still have room for a man to pass behind the board and work on the circuits." Dr. Scott also referred to the desirability of using glass for insulation rather than porcelain, because it was sometimes very difficult to detect a defect in the glazing upon which the successful use of porcelain depends. Others taking part in the discussion were C. G. Matthews, of Galveston; F. R. Slater, of Dallas; Mr. Robinson, of Galveston; Mr. Evans, of Yorktown, and W. R. Phipps, of Galveston.

The next paper was by A. L. Chase, superintendent of the Clarendon Light & Power Company, and was entitled "Oil Engines for Light and Power Plants in Small Towns and Cities."

Oil Engines for Small Plants.

This paper discussed the choice of prime mover for the lighting plant in a town of 2,500 population where the price of coal is $3.75 per ton and distillate oil five cents per gallon. It was found to be a losing proposition to operate 24 hours with steam equipment and in rehabilitating the station two oil engines of capacities 50 and 100 horsepower, of the two-cylinder, vertical low-compression, make-and-break-ignition type, were installed, with 60-cycle, three-phase, 2,300-volt generators. The first cost of these engines was about $65 per horsepower. Fuel cost was cut from $225 to $164 per month and no trouble was experienced in operation.

F. C. White, of Amarillo, opened the discussion by calling attention to the fact that Mr. Chase's fuel cost per kilowatt-hour was 1.5 cents, which was very low. A number of the members entered into the discussion of the comparative economical operation of the different kinds of engines and expressed the opinion that oil engines would be more economical than now if the engineers were as familiar with the operation of oil engines as they are with steam engines, and that the manufacturers were making a big mistake in advertising that it did not require an expert to run an oil engine, whereas under practical conditions it was essential to get economical operation.

Thursday Afternoon Session.

The very interesting paper by E. D. Kelly, manager of the Terrell Electric Light Company, on "Economic Operation in the Small Towns," started the afternoon session.

This paper pointed out the differences in the operation of an electric light plant in a town of population less than 10,000 as compared with the large city. Customers are naturally more scattered and the use of electric light less profuse. The costs of distribution plant and losses in operation are consequently greater in proportion. The organization of the company cannot be so thoroughly systematized and departments must overlap to a considerable extent. It is also impossible to keep so large a reserve of material, machinery, or labor. Full co-operation is necessary between all employees to achieve the best results. The author described how in his own town competition with a municipal plant had been successfully made. For small residences a flat rate of $1.00 per month for the first 50 candlepower and 30 cents for each additional 16-candlepower lamp was offered, a limiting device being used. For show-window lighting and signs, 1.5 cents per watt per month was adopted as a flat rate, the lights being controlled by a night watchman.

E. W. Kellogg, general manager of the Beaumont and El Paso Companies, opened the discussion by saying: "The man running a small plant must not imagine that the mere working up of a large organization will get him out of his trouble; the trouble with a great many of the plants is that they are over-organized. To my mind the most interesting fact this paper has shown is that just because a plant is small and has not got departments is no reason why, with good hard work and old-fashioned commercial methods, a remarkable showing cannot be made. I think the fact that Mr. Kelly increased his customers from 97 to 400 is probably a record that the largest cities could not duplicate with all their organization."

W. J. Norton then read his paper on the proper basis of rates for electric, gas, and water utilities in Texas, in which he brought out very clearly the desirability of having a uniform basis of rate as distinguished from a uniform rate.

The Friday morning session was opened by an address by Frank Watts, reigning Jupiter of the Jovian Order.

A. C. Scott, of Dallas, then presented a paper on the subject, "Purification of Feed Water for Steam Boilers."

This paper pointed out the necessity for giving attention to the quality of water used in steam boilers. The water of Texas was discussed, the properties of the water being considered from three main sources; lakes and ponds, rivers, and wells. A table was given showing the waste of fuel for different thicknesses of scale, and the other disadvantages in scale were pointed out. Methods of reducing the trouble were then taken up as follows: (1) cold processes for softening the water; (2) the hot-process system; (3) live-steam purifiers; (4) boiler compounds.

Mr. Cherry, of Weatherford, stated that they had been using a boiler graphite for cleaning their boilers, and that the tubes were just as clean as they were when they began using them.

H. S. Cooper stated that where the tubes were absolutely clean, with no scale, that you seem to get an electrolytic deposit just the same as nickel-plating or silver-plating.

W. L. Wood, Jr., of Texarkana, said that he certainly appreciated Dr. Scott's statement that a boiler should not be used as a settling tank. He stated that after considerable experimenting he had found the 3.5-inch LaGonda cleaner very satisfactory.

Dr. Scott was kept busy answering questions of local interest for some considerable time.

Secretary Cooper then presented his report of the work of the permanent secretary's office.

Saturday Morning Session.

The final session of the convention was devoted to reports of committees and routine matters. The Nominating Committee reported the following officers, who were elected for the ensuing year: president, G. H. Clifford, Fort Worth, Tex.; first vice-president, D. B. Fisher, Dallas; second vice-president, W. L. Wood, Jr., Texarkana; third vice-president, E. W. Kellogg, Dallas; treasurer, J. B. Walker. The selection of a secretary was left to the Executive Committee, but a motion was passed requesting the Executive Committee to re-appoint H. S. Cooper, of Dallas, as secretary for the ensuing year.

The entertainment program was fully carried out and included an open-air concert and dance on Wednesday evening; a luncheon at the Oleander Country Club; a dinner and dance at the Oyster Farm on Thursday evening; a boat excursion on Friday afternoon to Galveston Jetties and Bettison's Pier, where an elaborate fish supper was served; and an auction-bridge party for the ladies.

The Jovians held a rejuvenation on Friday evening, when some 75 candidates were admitted to the Order, after which a luncheon was served.

The secretary's register of the attendance showed a total of 482 present at the convention. The feature of the simultaneous sessions was very successful and added greatly to the interest and value of the meeting. From a movement started heretofore and augmented this year, it is probable that sooner or later the Southwestern Electrical and Gas Association will make Galveston its permanent convention city.

Luminescent Neon Tubes.

English and French electricians fraternized most happily together in Pairs from May 20 to 24, 150 members and friends of the English Institution of Electrical Engineers joining with the members of the Société Internationale des Electricians in conferences on electric railroad traction, direct-current series transmission, mechanical devices in telephone exchanges, etc. Marcel Deprez presided at one day's proceedings and W. Duddell, of the English Institution, occupied the chair at another sitting. M. Eiffel held a reception at the top of Eiffel tower.

One of the six papers on electric railroad work was a general and economic, rather than a technical, study of electrification problems in the United States, by H. Parodi.

Perhaps the most noteworthy event was the lecture by Georges Claude on "Luminescent Neon Tubes," accompanied by experiments and projections. The lecturer showed how his process of separation of the elements of the air by liquefaction allowed him to get neon as an industrial and plentiful product, available for industrial purposes. He has been working for the production of luminescence and he said that neon's properties are, in fact, very remarkable; its spectrum is superb, though unfortunately it does not contain blue lines; moreover it makes light with great ease, as Professor Collie had demonstrated. This property in due to the fact that neon is very easily permeable to electric discharge; in place of 1,000 volts to traverse air, we need only 13 volts in the case of neon. Some of the difficulties that arose were met with in the following way. Neon is very sensitive to the presence of the smallest quantities of other gases and is entirely annihilated by them. It is, therefore, quite insufficient to fill the tube with very pure neon, as impurities escaping from the electrodes on the passage of the current prevent neon from vibrating. M. Claude's process of overcoming this difficulty utilizes the remarkable action of charcoal, of absorbing gases with the greatest avidity when strongly cooled. Neon is purified in the tube itself during the

passage of the current by means of charcoal cooled by liquid air, which removes impurities and leaves neon. The tube is then separated from the charcoal containers. Tubes thus obtained, however, had a very short life, resulting in the absorption of neon and the volatilization of the electrodes by the current. By increasing their surface sufficiently M. Claude has succeeded in decreasing this absorption in such a manner that it is nearly stopped, the life of the tube being greatly extended—beyond that of incandescent lamps.

The lecturer went on to indicate the advantages of neon tubes in comparison with nitrogen tubes, thus: (1) the necessary difference of potential is only one-third—a great advantage in respect of safety. (2) The candlepower is much greater, 200 candles per meter in place of 60; tubes are much shorter and so less expensive, and they can be manufactured at the factory and conveyed to customers finished. (3) Above all the efficiency is much better, 0.6 watt per candle in place of 1.7.

Broca and Laporte have experimentally shown that neon light is physiologically excellent and that it increases the visual acuity by 25 per cent. Unfortunately, said Mr. Claude, the light of neon is too red. This may be an advantage for certain illumination, but in most cases it is a grave defect. It is possible to correct this by mercury light which is very rich in green radiation. Mercury tubes such as the Cooper-Hewitt, utilize direct current of low tension, whilst neon tubes require alternating current of high tension. In regard to this serious difficulty, M. Claude devised correcting tubes that are ordinary neon tubes containing some mercury; these tubes, laid near the neon tubes, work with the same current. Correction thus obtained is said to be excellent, and it is possible to get a very agreeable illumination at a total rate of 0.8 to 0.9 watt per candle.

But if the usual applications require white light, red light is sometimes convenient. For instance, in luminous publicity work where dazzling light is desired, the lecturer suggested an excellent field for the neon lamp. By means of the de Beaufort tubes of small diameter, it can be arranged in desired forms and designs.

The railway between Bussoleno, Italy, and the French frontier was recently electrified. Three-phase locomotives are used. Energy is supplied to a substation at 50,000 volts, 50 cycles and transformed to 3,500 volts, 16 cycles for use on the trolleys. Regenerative braking is used on the downgrade stretches of the line.

The Heterodyne Receiving System.

At a meeting of the Institute of Radio Engineers, held in New York City on June 4, John L. Hogan, Jr., of the National Electric Signaling Company, presented a paper describing the principle and apparatus involved in the Heterodyne receiver. Much interest has been shown in this invention of R. A. Fessenden, especially since the recent test between Arlington, Va., and the United States Steamship *Salem,* in which it was used for long-distance communication.

Since the "beats" principle, upon which the heterodyne operates, is not generally understood, Mr. Hogan opened his paper by a discussion of the classification of radio receivers and of the addition of simultaneous wave motions. Radio receivers are of two broad classes; (1) the relay or "trigger" type, in which the received energy releases an amount of local potential energy which in turn operates an indicator to produce a signal, and (2) the "converter" type, which acts merely as a transformer linking the antenna and the indicator, and in which the signal is produced by energy actually received from the transmitting station. Receivers of the first class (such as filings coherers) are limited by their delicacy and inefficiency, while those of the second, such as the gas, liquid or solid rectifiers cannot utilize in producing a signal any more energy than that actually received. This has led to attempts to use microphonic or other telephone relays to amplify received signals, but in general these have been unsuccessful. A selective receiver which will amplify persistent waves but will not increase effects due to highly damped discharges (such as those of atmospheric interference) is needed in the art of radio transmission. The only receiver of this type is the Heterodyne, whose action is to give an indication by the conjoint operation of two high-frequency alternating currents, one received from the transmitter and the other usually generated at the receiving station.

Mr. Hogan illustrated by lantern slides the graphical addition of waves of various types, treating mathematically the several cases. The production of acoustic beats by organ pipes and singing flames was shown, and the distinction between polarized and non-polarized indicators demonstrated by generation of inaudible air-wave beats with Galton's whistles.

Five types of heterodyne receiver were described. In the first, two streams of waves having slightly different frequencies were received on two separate antennas. Currents set up by them passed through the coils of a non-polarized magnetic telephone and reacted on its diaphragm to produce audible signals. In the second form, a single antenna was used, one of the two interacting currents being generated by an alternator, arc or other oscillator at the receiver. The third form shown had its sensitiveness increased by use of a dynamometer telephone, and the fourth type was made still more effective by the use of a static telephone receiver.

With this last arrangement of heterodyne apparatus signals had been received over 3,000 miles, in spite of the notoriously low sensitiveness of the static telephone. The great increase in effective sensitiveness could be explained by a theory of operation which had been proposed, and which indicated that the static telephone used upon the heterodyne principle would respond to a given strength of sustained wave several hundred times as loud if used simply.

The fifth type shown adds to the sensitive rectifier and telephone combination of modern receivers the amplifying power of heterodyne excitation. Receiving either from sustained-wave or spark transmitters, it is possible to read signals so weak that they cannot be heard with the ordinary receiving apparatus. On spark signals the intensity of heterodyne response is from 5 to 15 times as great, in audibility, as that of the best rectifier receivers operating normally, while on sustained waves the effective amplification is still greater. This increase of sensitiveness to continuous waves accounts for the long distance transmitted by the arc temporarily installed at Arlington and used for special tests during the cruise of the *Salem* to Gibraltar. During these trials all long-distance signals, whether from arc or spark sender, were received on the heterodyne, the ticker receiver having been abandoned after the earlier tests by the Navy engineers.

Data secured on the trials between Arlington and the *Salem* permitted modification of the constants in the Austin-Cohen transmission expression so as to allow for the increased sensitiveness of the heterodyne. Extending such data it is found that two stations of the Arlington type could exchange messages regularly by day and night over a distance of 4,500 kilometer (2,800 miles) or could transmit between them dayligh signals of 25 times audibility (readable through light static) even if 5,500 kilometer (3,400 miles) apart. These distances would be impossible with anything like similar transmitting power with any other receiver.

New Electrical and Mechanical Appliances

Direct-Current, 2,400-Volt Locomotives for Butte, Anaconda & Pacific Railway.

The electrification of the Butte, Anaconda & Pacific Railway is of exceptional interest because it represents one of the largest installations of electrical equipment for steam railroad service and the first in this country where didect-current locomotives operating on as high a potential as 2,400 volts will be employed. Construction work necessary to effect the change from steam to electric equipment is now practically completed.

The adoption of the system selected for this railway was determined after a comprehensive study of local conditions and requirements. The traffic demands are unusually severe and consist principally of hauling long trains of copper ore over heavy mountain grades. In comparison with other existing systems the 2,400-volt direct-current was considered best suited for exacting service of this character, for its adoption presented an opportunity to realize unusual economies both in initial expenditure and the cost of operation.

The section of the road that has been equipped lies between Butte and Anaconda, Mont. It comprises 30 miles of main-line single track, and numerous sidings, yards and smelter tracks aggregating a total of about 90 miles on a single-track basis. The haulage of copper ore from the Butte mines to the smelters at Anaconda, together with all mine supplies, lumber, etc., moving in both directions, amounts to practically 5,000,000 tons of freight per year. Complete freight trains weighing 3,400 tons are made up of 50 loaded steel ore cars and will be handled against a ruling grade of 0.3 per cent by a locomotive consisting of two of the units illustrated. Single units will be used for making up trains in the yards and for spotting cars.

The initial equipment consists of 17 locomotive units, 15 for freight and 2 for passenger service. Each unit weighs approximately 80 tons. The two units for forming the freight locomotives in each case will be coupled together and operated as a multiple-unit set. The combination freight locomotive will haul the usual trains of 3,400 tons at a maximum speed of 15 miles per hour against the ruling grade and at 21 miles per hour on level tangent track.

The passenger locomotives are of the same design as the freight locomotives, except they are geared for a maximum speed of 45 miles per hour on level tangent track. A schedule of eight passenger trains per day, four each way, is maintained, the average train being composed of a locomotive and three standard steam-road passenger coaches. All the locomotive equipment, as well as the substation apparatus and overhead line material, was designed and built by the General Electric Company. One of the locomotives is on exhibition at the Master Mechanics' and Master Car Builders' conventions, Atlantic City, N. J., June 11 to 18, inclusive.

The locomotives are the articulated double-truck type with all weight on the drivers. The cab, containing an engineer's compartment in each end and a central compartment for the control apparatus, is carried by the two truck frames on center pins. On each axle is mounted a motor of the twin-geared type. The friction draft gear mounted on the outer end frame of each truck transmits the hauling and buffing stresses directly through the truck frame, diverting these strains from the center pins and under-frames.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles	37 ft. 4 in.
Length over cab	31 ft.
Height over cab	12 ft. 10 in.
Height with trolley down	15 ft. 6 in.
Width over all	10 ft.
Total wheel base	26 ft.
Rigid wheel base	8 ft. 8 in.
Total weight	160,000 lbs.
Weight per axle	40,000 lbs.
Wheels, steel tired	46-in.
Gears, forged rims, freight locomotives	87 teeth
Gears, forged rims, passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth
Pinions, forged, passenger locomotives	25 teeth
Tractive effort at 30 per cent coefficient	48,000 lbs.
Tractive effort at one-hour rating	30,000 lbs.
Tractive effort at continuous rating	25,000 lbs.

The trucks are built of heavy steel castings. The side frames are of a truss pattern with heavy top and bottom members and pedestal tie bars. They are connected by end frames and a cast-steel center transom. The entire weight is carried on semi-elliptic springs suitably equalized. The cab underframe consists of two 12-inch longitudinal steel channels on either side of the center and two 6 by 6-inch steel angles along the outer edge. The central channels are inclosed and form a distributing air duct for forced ventilation. Air is conducted through the center pins, which are hollow, into the truck transoms and thence to the motors.

The engineer's compartment, at either end of the cab, contains the operator's seat, controller, air-brake valves, air gauges, ammeter, sanders and other control apparatus that should be within reach of the engineer. These compartments are comfortably heated by electric heaters.

In the central section is grouped the control apparatus. The contactors, reverser and rheostats are mounted in two banks running lengthwise of the compartment and are arranged with ample space between them to afford convenient access for cleaning, inspection and repair. All parts and circuits carrying 2,400 volts are thoroughly protected from accidental contact. A dynamotor is employed to furnish 600 volts for the operation of the contactors, lamps and air compressor.

The motors are of the GE-229A commutating-pole type, wound for 1,200 volts and insulated for 2,400 volts. A forged pinion is mounted on each end of the armature shaft and meshes into a corresponding gear mounted on the wheel hub. The gear reduction is 4.84 on the freight locomotives and 3.2 on the passenger locomotives.

The motors are designed especially for locomotive service; they are inclosed and provided with forced ventilation. Air is circulated over the armature and field coils, over and through the commutator, through longitudinal holes in the armature core, and thence exhausted through openings in the bearing head. This method of ventilation circulates effectively a large volume of cool air throughout the motor and keeps all parts at a uniform temperature, eliminating the possibility of hot spots.

The continuous capacity of each motor is 190 amperes at 1,200 volts under forced ventilation, and 225 amperes at 1,200 volts for the one-hour rating. For the double-unit locomotive this is equivalent to a continuously sustained output of 2,100 horsepower.

The control equipment on the locomotive is the Sprague-General Electric type M multiple-unit control, and is designed to operate the four motors in series and series-parallel. The pairs of motors with their respective resistances are all connected in series on the first point of the controller. The resistance is varied through nine points on the controller and finally short-circuited on the tenth or running point. The pairs of motors are then operated similarly in series-parallel and all resistance is cut out on the nineteenth point, which is the full-speed running point. This provides a control with ten steps in series and nine steps in series-parallel.

The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The smooth transition between control points permits acceleration close to the slipping point of the wheels. A switch is provided having manually operated handles for cutting out either pair of motors, so that the locomotive can then be operated with one pair of motors.

The contactors are actuated by the 600-volt circuit obtained from the dynamotor and are of a design similar to that employed in the standard type M control. The principal variations are embodied in the method of insulating for the higher voltage. The arm between the operating armature magnet and the arc-chute mechanism consists of a treated wood spacer insulator; and the contacts and magnetic blowout, which make and break on the 2,400-volt circuit, are mounted on mica and porcelain insulators.

The main switch is provided with a powerful blowout so that heavy currents can be opened. The three smaller switches, one for each of the two heaters and one for the dynamotor circuits, are designed specially for 2,400 volts. The blade is controlled by a lever attached to the grounded part of the locomotive frame and insulated from the live parts of the switch by a rod of treated wood.

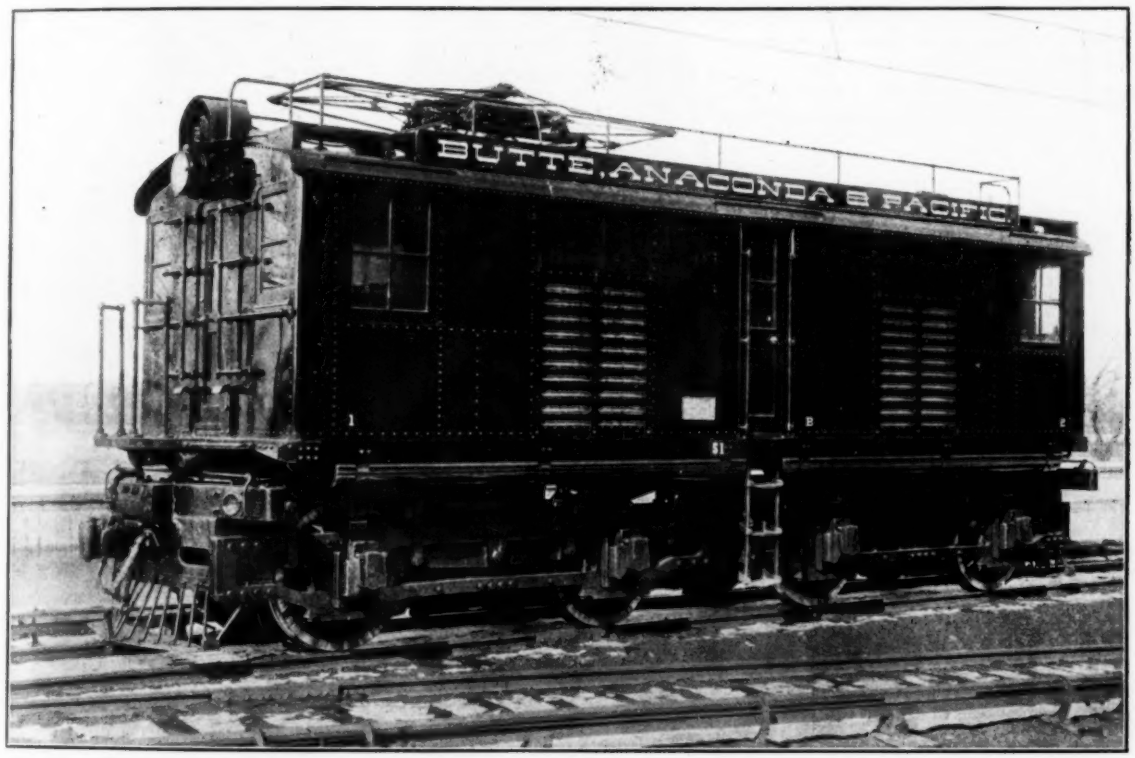
There is one main fuse for the trolley circuit and two fuses for the motor circuits. They are all of the copper-ribbon type and are fitted with hinged covers to facilitate renewals. The fuse boxes are located as near as possible to the overhead trolley in order to protect the wiring circuits near the sources of supply. There is also an auxiliary circuit fuse for protecting locally the dynamotor and heater circuits. The main, motor and auxiliary fuse boxes are provided with powerful magnetic blowouts, energized by current passing through the fuse, to insure proper rupture of the arc.

An ammeter is located at each engineer's position and indicates the current in the circuit of one pair of motors. The ammeter and air gauges are illuminated by a gauge light connected in the headlight circuit, so that the headlight switch turns on simultaneously the headlight and gauge light at the same end of the locomotive.

The main motor rheostats are formed of cast-iron grids assembled in a frame and insulated by mica; 20 resistance units are provided for each passenger locomotive, and 26 resistance units for each freight unit. The rheostat boxes are mounted in an inclosed compartment above the banks of contactors.

Current is collected by overhead trolleys of the pantograph type. They are pneumatically operated and can be put into service from either engineer's compartment by a hand-operated valve. Each passenger locomotive is equipped with two collectors, and each freight unit with one collector. A 2,400-volt insulated bus line connected direct to the pantograph is run along the center on the roof of the cab. The bus lines are connected by couplers between the two units of the freight locomotive, so that current is obtained from both collectors or from a single collector.

The locomotives are equipped with



2,400-Volt Direct-Current Locomotive for Montana Railway System.

arc headlights. The interior illumination of the cab is provided by ten incandescent lamps arranged in two circuits, one lamp being placed in each engineer's cab and the balance in the central compartment. In each lamp circuit is a portable lamp with an extension cord. One lamp switch is located in each engineer's cab, so that one lamp circuit can be controlled from each end of the locomotive. A 600-volt bus line is provided from the passenger locomotives for lighting and a 2,400-volt bus line for heating the passenger coaches.

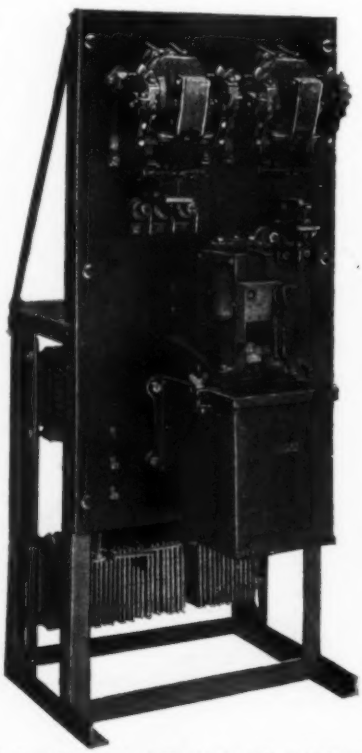
The air brakes are of the combined straight and automatic type. The air compressor is two-stage, motor-driven, and has a piston displacement of 100 cubic feet of air per minute when pumping against a tank pressure of 135 pounds per square inch. Air is taken from the interior of the central compartment through a screen to prevent the entrance of particles of dust. The compressed air in passing from the low-pressure to the high-pressure cylinder is conducted through radiating pipes on the roof of the cab. This reduces the temperature of the air and allows condensation of moisture before entering the high-pressure cylinder. From the latter it is delivered into four air reservoirs, each 12 by 164 inches. They are located under the floor of the cab and connected in series, which affords a further opportunity for radiation and condensation.

Pneumatic sanders are provided. The sander valves are located within convenient reach of the engineer's seat, and valves and boxes are arranged for sanding the track in front of the leading wheels when running in either direction. The couplers are M. C. B. standard. The bells are fitted with automatic bell ringers, and the whistles are air-operated. All wiring is drawn through conduits and carefully protected from possible mechanical injury.

Automatic Controllers for 1,100 and 2,200-Volt Motors.

High-voltage motors are being used to a great extent on waterworks systems, in industrial plants for compressor service, etc. Many power companies distribute energy in cities at 1,100 and particularly at 2,200 volts, so that the use of motors designed for these voltages eliminates the necessity of step-down transformers. A new line of automatic control panels has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., for use with high-voltage slip-ring induction motors. One type is designed especially for use with motors driving reciprocating pumps, air compressors or other machines which must be started under full-load conditions, and which require a starting torque equal to or in excess of the normal full-load torque of the motor. The other line, having the same appearance as that shown in the accompanying illustration, is designed for use with motors driving centrifugal pumps, or machines of similar load characteristics, starting under light-load conditions.

The acceleration is controlled by resistance in each of the three phases of the rotor which is cut out, step by step, by double-pole magnetic switches under the control of current relays. By adjustment of the relays the starting current can be set at a predetermined value and the motor accelerated in the shortest time consistent with this current. An oil-immersed solenoid-operated three-pole switch is also mounted on the panel which controls the high-tension motor primary circuit. Where used on water systems, air or vacuum systems, suitable accessories such as float switches, gauges, diaphragm-type pressure regulators and vacuum regulators are available.



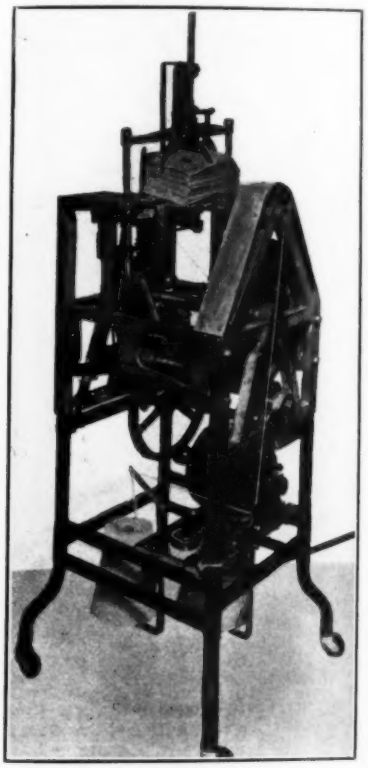
Automatic Control Panel for High-Voltage Motors.

Automatic Package Tier.

A few seconds saved in operations that must be constantly repeated mean many minutes by the end of the day, and the saving of minutes often means the saving of many dollars in a busy office. That is the reason why small motor-driven machines are being used so extensively in modern business houses for operations such as sealing and stamping envelopes, opening letters, running adding machines, duplicators, addressographs, etc.

One of the latest of these time and labor-saving devices to make its appearance is the automatic package tier. It is designed primarily for tying mail matter into packages, but has many other applications besides.

It takes bundles of from 25 to 50 letters, and in 2.5 seconds binds them into a neat, compact package and drops them into the mail bag or other receptacle. Where much mail matter is handled, it permits a reduction of the clerical force and enables earlier mails to be caught. The United States Post Office is one of its many users.



Motor-Driven Package Tier.

The machine is made by the Automatic Package Tier Company, Chicago, Ill. It is driven by a one-eighth-horsepower Westinghouse motor taking current from the lighting circuit.

Telephone Storage Batteries Prove Reliable Through Flood.

It is sometimes stated that storage batteries will not stand much abuse and that in order to give service they require constant care and must be operated under ideal conditions.

A striking proof that storage batteries are reliable and that they will operate even under the most adverse conditions is shown in the experience of the Cincinnati Suburban Bell Telephone company during the recent flood in the Ohio Valley.

This company has two batteries of the Chloride Accumulator type located at its exchange in Hamilton, O., One battery consists of 11 cells of type G-11 and the other battery of 11 cells of type F-9. The entire power plant in which these batteries were located was submerged in the muddy water of the Miami River about 6 o'clock on the evening of March 25 and remained under water over 48 hours.

During this submersion the batteries continued to furnish the necessary current for signaling and transmission from the time of their submersion until 3 a. m. on March 27. As soon as the water had subsided sufficiently to allow an inspection, voltage and gravity readings were taken on the first set and showed three volts for the entire 11 cells and a specific gravity of 1.153 in the cell tested.

As soon as the power plant could be put in commission, which was at 1:25 p. m., on March 29, the batteries were put on charge and continued so until about 10 p. m. on the same day without there having been any repairs of any kind made on these cells. The charge received during this time continued to operate the exchange during the remainder of the night and well into the next day.

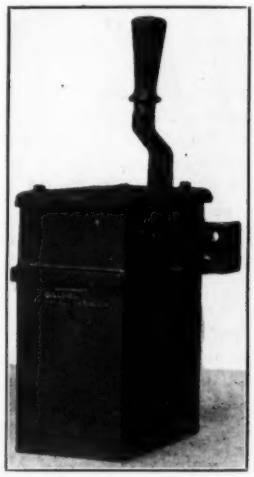
New Oil Starting Switches for Squirrel-Cage Motors.

A new line of starters, which has recently been put on the market, is designed to supply reliable, economical, and sparkless switches for starting small squirrel-cage motors directly from the line. They are for use in all industries and are specially applicable to textile and powder mills, and other places where all possibility of sparking must be eliminated.

Starting Switch with Horizontal Lever.

The contacts are immersed in oil and all parts except the handle are inclosed and protected from dust and dirt. Every part, however, can be readily exposed for inspection. Openings in the casing are provided, so that the leads can be run through conduit. The switches are self-contained and no resistors are needed. They are made in capacities up to 10 horsepower for both reversing and non-reversing service and can be arranged for either hand or remote operation.

These starters, which are known as

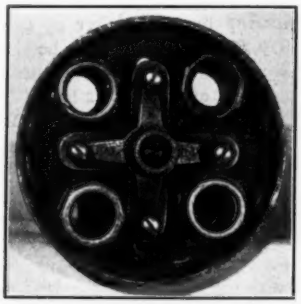


Starting Switch with Vertical Lever.

type T starters, are made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Denver Adjustable Fixture Stud.

W. S. Earhart, 2932 Columbine Street, Denver, Colo., has invented and placed on the market what is known as the Denver adjustable electric fixture stud. This consists of a steel bolt having a cone-shaped head which is dropped in



Denver Adjustable Fixture Stud.

place of the gas knockout in conduit outlet boxes at the time of installation and hence cannot be stolen and is therefore always intact for the support of fixtures. To this bolt is fitted a crow foot which is adjustable by four set screws, this plate being held to the bolt by a three-eighths-inch bushing which connects with the standard insulating joints of fixtures.

With this adjustable fixture stud it is possible to hang fixtures plumb on all outlet boxes whether or not the latter are placed out of a horizontal plane by the wireman. It has been found that in a large percentage of the boxes which are placed properly by the mechanic, the fixtures themselves hang out of line due to inaccuracy in the threads of the stem or insulating joint. A great many fixtures are weakened in bending them to hang somewhere near plumb on the present stiff stud which does not allow of any adjustment. Therefore fixtures hung with the Denver adjustable fixture stud make a better job electrically because the whole weight of the fixture rests on the head of a heavy bolt secured direct to the iron plate of the outlet box and even on a very crooked outlet box the fixture hangs perfectly plumb and naturally, so that there is no abnormal strain in any part of it. This stud is patented, and approved by the Underwriters' Laboratories.

More Than 2,200 Miles of Additional Telephone Train Dispatching.

The success attending the adaptation of the telephone to train-dispatching work a little over three years ago may be measured by the fact that at the beginning of 1913 there were about 70,000 miles of road in the United States and Canada using this method of controlling the movements of trains. Changing over from one method of train dispatching to another is a process which necessarily entails a great deal of deliberation on the part of railroad officials and such a radical change as that from telegraph to telephone requires considerable time for its consummation. The fact that 70,000 miles out of a possible 265,000 or over 30 per cent have been equipped with telephones in the comparatively short space of four years is indisputable evidence of the good work being done with the new system. Since the beginning of the year, apparatus for a large number of extensions to existing equipments has been ordered and a number of other railroad systems have placed orders for their first telephone lines.

The Iowa Railway & Light Company which operates the Cedar Rapids & Iowa City Railway has ordered telephone train-dispatching apparatus for equipping its entire line. This railroad runs from Cedar Rapids to Iowa City, Iowa, a distance of approximately 30 miles, operating its passenger trains by electricity and freight service by steam; 10 way stations will be equipped with telephones and selective signaling apparatus. Portable telephones will be furnished for the use of train crews. These telephones will be fitted with cords and plugs arranged

for plugging into pole jacks which will be placed at a convenient height on telephone poles along the right of way. This arrangement will make it possible for train crews to communicate with headquarters from any point on the line, and is especially valuable in emergencies. The train dispatcher will be located at Cedar Rapids.

The Lehigh & New England Railway Company will equip at present about 120 miles, the remainder of the line will be equipped at a future date. The present telephone circuits will extend from Lanford to Hainesburg Junction, Pa., with spurs running from Benders Junction to Bethlehem and from Bath Junction to Martin's Creek. The dispatcher will be at Bethlehem; 21 way stations will be equipped with telephones. There will also be 16 siding telephones installed at points along the line.

The Seaboard Air Line has placed an order for apparatus to be used in extending its telephone dispatching circuits from Columbia, S. C., to Jacksonville, Fla., a distance of approximately 285 miles. A total of 34 way stations has been equipped with desk-type telephones and selector sets for signaling. The dispatcher is located at Jacksonville.

Seven circuits are to be equipped on the Missouri, Kansas & Texas Railway, making a total of 1,000 miles of new telephone lines. Way stations will be equipped with selector sets for selective signaling and telephone arms of the folding-gate type for talking. The divisions to be equipped are as follows: Muskogee division extending from Osage to McAlester, Okla., a distance of 186 miles, with the dispatcher at McAlester; 23 way stations will be equipped. San Antonio division from San Antonio to Smithfield, Tex., a distance of 101 miles, with the dispatcher at Smithfield; 11 way stations will be equipped. Houston division from Houston to Smithfield, Tex., a distance of 117 miles, with the dispatcher at Smithfield; 13 way stations to be equipped. Sedalia division from Sedalia to Parsons, Mo., a distance of 160 miles, with the dispatcher at Parsons; 28 way stations to be equipped. Kansas City division from Kansas City to Parsons, Mo., 107 miles, with dispatcher at Parsons; 19 way stations to be equipped. St. Louis division from St. Louis to Sedalia, Mo., 227 miles, with dispatcher at Sedalia; 31 way stations to be equipped. Cherokee division extending from Wagoner, Okla., to Parsons, Mo., 102 miles, with dispatcher at Parsons; 16 way stations to be equipped. The Missouri, Kansas & Texas lines will also be equipped with 150 siding telephones. Wire chief's test panels and apparatus cabinets equipped with simplexing relays, resistances and protectors for the dispatchers' offices will also be furnished.

Two new telephone train-dispatching circuits have been added to the lines of the New York Central system. One circuit extends from Oswego to Rome, N. Y., with a side line bridged on at Richland and extended to Watertown, making a total mileage of 101; 23 way stations are to be completely equipped with telephones. The dispatcher is located at Oswego. The other circuit extends from Oswego through Richland to Syracuse, N. Y., a distance of 70 miles; 18 way stations are being equipped. The dispatcher for this circuit is also located at Oswego.

Additions to existing circuits are to be made by the Chicago & Northwestern Railway Company. One new telephone-dispatching line is to extend from South Pekin to Benld, Ill., a distance of approximately 105 miles; 23 way stations are to be equipped with telephones on this new division of road. A message circuit for handling telephone traffic other than train dispatching will be installed over the Peoria division and will extend from Nelson to South Pekin, Ill., a distance of about 85 miles; 18 way stations will be equipped. The dispatchers for each circuit will be located at South Pekin. Thirty-eight waiting-room telephones are to be installed in the stations along these two divisions.

The Chicago, Burlington & Quincy is planning to add three new train-dispatching and one message circuit and has placed orders for the necessary apparatus. The message circuit and one of the dispatching circuits will be installed over the division extending from Burlington, Iowa, to Hannibal, Mo., a distance of approximately 100 miles with the dispatcher at Hannibal. A total of 22 selector sets and telephones will be furnished for the way stations along the line. Another of the train-dispatching circuits will be installed between Alliance and Ravenna, Neb., a distance of about 240 miles. A dispatcher will be located at Alliance; 27 way stations will be equipped with telephones and selective signaling apparatus. Apparatus for one blocking circuit will also be furnished with 25 station equipments. This provides for making connections between different circuits and connecting telephone sets to train, message or block wires in either of two directions. The third dispatching circuit is to extend from Creston to Pacific Junction, Iowa, with the dispatcher at Preston. This division, which is about 65 miles long, will have 23 way stations equipped with telephones.

The Denver & Rio Grande Railroad has purchased a quantity of composite equipment for use on its lines. This equipment consists of 72 wall sets for use at way stations and 26 portable sets for the use of train crews. These portable sets are equipped with cords and line poles so that communication may be established with headquarters from any point on the line by merely hooking the line pole over the telephone wires which parallel the track.

All of the telephones, selector equipments and auxiliary apparatus required for the foregoing installations and extensions have been ordered from the Western Electric Company. The railroads have also found it profitable to install telephones for the handling of communications other than dispatching messages. Roads already using this method of communication over a part of their right of way are constantly adding to their equipment.

Protecting Crops by Telephone.

A novel application of the rural telephone to one phase of farming conditions has been made by the Wood River Orchard Company, operating fruit orchards near Weiser, Idaho. It is a well known fact that one night of frost may spoil an entire season's crop. The Wood River Company having this in mind decided to take measures whereby it could get ample warning of the approach of frost and make preparations in time to ward off its bad effects on the apple crop.

Thermometers of the dial type are placed in each of the four corners of the valley. On each dial face there is a platinum contact which can be moved to any point on the dial, while another contact point is located on the indicator needle. For orchard use the dial contact point is placed at about 45 degrees Fahrenheit. When the temperature drops to this point, the two contact points come together and close a local circuit. In this local circuit there is an interrupter or pole-changer arranged to send an alternating current over wires which connect with a Western Electric No. 1,800 sectional unit type switchboard at the main office of the company. This alternating current operates a signal on the switchboard and indicates to the operator that frost is near at hand.

The switchboard operator having received the signal, calls each of the orchard men who would be affected by the frost. They in turn go through their orchards and light smudge pots which have been installed there at the beginning of the season when frosts are prevalent. The time that elapses from the instant that the thermometer circuit is closed until the last orchard man is notified is not over five or ten minutes at the utmost.

Current Electrical News

LIGHTING AND POWER.

(Special Correspondence.)

SHELLSBURG, IOWA.—Electric lights will be installed here. C.

EAST PERU, IOWA.—An electric light system will be installed. C.

CROOKSTON, MINN.—An electric light plant will be established here.

LARIMORE, N. D.—A "White Way" system is to be established here.

STATE CENTER, IOWA. — A "White Way" system will be installed in the near future. C.

WARREN, MINN.—Plans are being discussed on the proposition of enlarging the city lighting plant. C.

HOMER, ILL.—U. G. Thompson, proprietor of the power plant here is planning the erection of a new plant.

SPENCER, N. C.—The Board of Aldermen has decided to issue $50,000 in bonds for water and lights.

SIDNEY, NEB.—This place has voted to issue $22,000 in bonds for an electric-light and steam-heating system.

MYRTLE POINT, ORE.—The City Council contemplates the construction of a municipal electric light and power plant here. O.

BURLINGTON, IOWA.—An ordinance passed providing for the placing of electric-light and power wires underground. C.

LINCOLN, NEB.—The city will extend the street lighting system. Tungsten lights may replace the arcs now in use. Z.

CROOKSTON, MINN.—$30,000 in bonds will be issued for the purpose of erecting an electric lighting plant and water system. C.

KENMARE, N D.—The Mayor is interested in a movement which is on foot to establish a "White Way" system in this place.

GRAND FORKS, N. D.—The municipal electric light plant will be improved by the addition of about $15,000 worth of new machinery. C.

POVELLE, IOWA.—The Electric Light Company is planning to change its present system of lighting into a three-wire system. C.

MASON CITY, ILL.—The Commercial Club has decided to install ornamental lights in the business section of Mason City. Z.

WACO, TEX.—It has been decided that all electric companies in this city must place their wires underground in the fire district at once.

WARDEN, WASH.—The Washington Water Power Company is making arrangements to extend its power lines into Hartline this season. O.

FREDERICKSBURG, VA.—A franchise has been granted to the Rappahannock Electric Light & Power Company to operate in this city.

ST. THOMAS, N. D.—St. Thomas will invest $7,000 on a light and power plant. Two 50-horsepower engines will be purchased and installed. C.

NESHKORO, WIS.—Charles T. Dahlike, of this place, has been granted a 20-year franchise to furnish electric street lights in Eautomie.

WASHINGTON, IOWA.—The lighting system of Washington is to be changed. The light committee will prepare plans for immediate change. C.

RUSSELL, IOWA.—At the town election the electric light proposition carried and a line will be built to Chariton, where connection will be made.

GRAND FORKS, N. D.—The City Council has decided to improve the municipal electric light plant. Additional equipment to cost about $13,000 will be installed. Z.

DENISON, IOWA.—The Council will grant a franchise to the Denison Utilities Company, providing $30,000 be expended in improvements during the next two years.

CAMPBELL, MO.—The Campbell Mill & Light Company is planning to construct 11 miles of transmission line. T. R. Hutchinson is president of the company.

LAPEER, MICH.—A committee has been appointed to investigate the cost of installing a boulevard system of street lighting for Nepessing Street. Address the city clerk.

FRANKFORT, S. D.—Plans for the new electric light system which it is proposed to install in Frankfort have been prepared and bids will be received for installing the system. C.

ALTOONA, PA.—It is said that the Penn Central Light & Power Company will expend $1,000,000 on a new water-power plant at Williamsburg with a capacity of 30,000 horsepower.

HUDSON, S. D.—The Hudson Electric Light & Power Company has been incorporated with a capital of $10,000 by J. B. Vradley, C. F. Johnson, T. H. Terkleson, P. F. Way and others. C.

BONNERS FERRY, IDAHO.—A. H. Featherstone, of Wallace, Idaho, has located the Moyea Water Power Light at Moyea Falls, and contemplates the construction of a 10,000-horsepower plant.

WATOMA, WIS.—A 20-year franchise has been granted to C. T. Dahlke, of Neshboro, to furnish the residents of this village with electric light and also to install a system of electric street lights.

DOVER, IDAHO.—O. N. Nash, representative of the Northern Idaho & Montana Power Company, is investigating the feasibility of extending power and light lines from Sand Point to this city. O.

PIERRE, S. D.—The Hudson Electric Light & Power Company, Hudson, has been incorporated with a capital of $10,000 by J. B. Vradley, C. F. Johnson, T. N. Torkelson, P. F. Way, and others, all of Huron. C.

BURT, IOWA.—The Burt Light & Power Company has been incorporated with a capital of $15,000 by L. M. Owens, president, M. J. Mann, vice-president, C. B. Chipman, secretary, H. O. Beull, treasurer. C.

BROOKLINE, MASS.—The Selectmen have granted permission to the Edison Electric Illuminating Company of Boston to construct underground conduits in Salisbury and Warwick roads and Beacon Street. W.

DALLAS, TEX.—The City Commissioners are discussing the feasibility of establishing a municipal light plant at Turtle Creek pumping station. Address City Electrician Leon Taylor for information.

COSHOCTON, O.—Lafayette Light & Power Company has been incorporated with a capital stock of $10,000 by C. H. Howell, K. K. Garrett, Ed A. Crawford, W. A. Simebaugh and F. E. Pomerene.

TULSA, OKLA.—Ox Bow Ben Power Company has been incorporated with a capital stock of $100,000 by C. P. Chenault, L. D. Lewis, Floyd C. Lewis, J. O. Campbell and L. W. Mason, of this city.

CEDAR FALLS, IOWA.—Engineer C. H. Streeter has the plans completed for the new municipal lighting plant and it is understood matters will take definite form upon the sale of the light bonds.

DOWNIE, IDAHO.—The Utah Light & Power Company will begin active operations in building an electric lighting and power system in this city at once. A franchise has been granted by the Council. O.

BURLINGTON, IOWA.—The City Council has taken action to place all electric wires except those needed in the operation of the street railway system underground in the down-town district. Address the city clerk.

FREEHOLD, N. J.—The Board of Public Utility Commissioners has approved of an ordinance granting the Farmingdale Lighting Company permission to install a system on the road between Farmingdale and Freehold.

FORT WORTH, TEX.—The Fort Worth Power & Light Company will double the capacity of its electric light and power plant here. Among the equipment to be installed are eight new boilers with a total of 4,000 horsepower. D.

BAYONNE, N. J.—The City Council has instructed its Water & Street Committee to formulate a plan, to be incorporated in an ordinance, requiring the Public Service Electric Company to replace its overhead lines with an underground conduit system in the city. A.

COQUILLE, ORE.—From an au-

thentic source comes the information that the Oregon Power Company is negotiating for the purchase of the Morris electric power plant here. If negotiations are successfully culminated, extensive improvements will be made. O.

OMAHA, NEB.—The Republican River Power Company has filed articles of incorporation and will proceed to acquire power rights and develop electrical power. The incorporators are F. B. McDonald, M. L. Gardner, A. E. Hansen, L. R. Yost and C. G. Eckman.

CINCINNATI, O.—A plan is under way by which the Columbia Gas & Electric Company will greatly enlarge its holdings in other electric companies and issue some $3,000,000 in bonds, which will be used for extensions and improvements, including new power houses and generating stations.

RICHMOND, VA.—The Virginia-Western Power Company, which was incorporated a short time ago with a capital stock of $626,000, has taken over several power companies and proposes transmission-line extensions and will develop several water-power sites which it owns.

LOUISVILLE, KY.—Having decided that electric elevators are much better than hydraulic ones, the Fiscal Court has decided to replace the present conveyors in the county courthouse with elevators of the modern electric-traction type. A contract for the improvement will be let in the near future. G.

VANCOUVER, WASH.—Washington Farm Land Company, through James P. Stapleton, of this city, has been incorporated with a capital of $1,000,000. The new company is a power concern. It is understood that the men connected with this project are identified closely with the Pacific Power & Light Company of Portland, Ore. O.

EAGLE PASS, TEX.—The Indio Cattle Company will construct an electric irrigation pumping plant upon its property near here. The International Electric Company will build a power transmission line from its central station here down the valley of the Rio Grande to the property of the Indio Cattle Company and supply power for this and other irrigation pumping plants in that section. D.

STERLING, ILL.—Hunter H. Wood is one of a company incorporated with a capital stock of $350,000 to furnish electric lighting to nearby cities. The corporation will start immediately asking franchises in the cities. The erection of an electric plant in Sterling to cost $2,000,000, will be started as soon as possible. Whiteside, Lee, Ogle Bureau, Henry, Corroll and Rock Island Counties will be served by this company.

SPOKANE, WASH.—A group of capitalists of this city, headed by Eugene Enloe, is organizing a $200,000 corporation, which will probably be known as the Okanogan Valley Power & Light Company, for the purpose of supplying power for light to the rapidly developing Okanogan district. The promoters are connected with the Big Bend Light & Power Company and the Grangeville Light & Power Company and have closed deals for the purchase of other similar concerns.

HARRISBURG, PA.—The following electric light and power companies have been incorporated, each with a capital stock of $5,000: The American Electric Light & Power Company, to operate in Catasauquq; Center Valley Electric Light & Power Company, to operate in Upper Saucon; Empire Electric Light & Power Company, to operate in Coplay; United Electric Light & Power Company, to operate in Northampton County; and the National Electric Light & Power Company, to operate in North Catasauquq.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

CLARKSVILLE, IOWA.—Articles of incorporation have been filed for the Unity Rural Telephone Company. C.

BISHOP, TEX.—The Bishop Telephone Company will extend its line to Kingsville. A. Hawkins is manager of the company.

HARRISON, ARK.—The Boone County Telephone Company has been organized here with a capital stock of $12,000. J. H. Fowler is president.

ENTERPRISE, ORE.—The Home Independent Telephone Company will build a telephone line from Enterprise to Sled Springs at once. O.

TRENTON, N. J.—The Delaware & Atlantic Telegraph & Telephone Company will install new equipment to cost approximately $100,000. A.

BISMARCK, N. D.—Bismarck is to be the headquarters for the North Dakota Independent Telephone system. Mr. Shuman is district manager. C.

HARLETON, MONT.—The Meagher County Telephone Company plans considerable work of repairing and installation in this city and nearby territory. O.

VANCOUVER, B. C.—The British Columbia Telephone Company intends to install 50 additional trunk lines between its Bay View and Seymour Exchanges at once. O.

BURLINGTON, IOWA.—The City Council has ordered telephone, telegraph and electric light wires in the down-town district placed underground. Z.

MENDOCINO, CAL.—George M. Dobel was here recently making preparations for the remodeling of the Pacific Telephone & Telegraph Company's lines.

SAN DIEGO, CAL.—It is reported that the Pacific Telephone & Telegraph Company is planning the construction of a new central station in the business district.

SALEM, IND.—Delaneys Creek Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are J. W. Benham, E. Williams and T. M. Landon.

URSA, ILL.—The Farmers' Mutual Telephone Company has been organized here. The company is planning to establish a line into Quincy. Address Frank Allison, president.

DOVER, DEL.—The Radio-Telegraph Company has been incorporated under the laws of this State with a capital of $10,000, the foremost incorporator being Oscar J. Reichard, of Wilmington, Del.

WEISER, IDAHO.—George Gilderoy, president of the Mann Creek Telephone Company, recently announced that a new line is to be added at once. Ten miles of wire will be strung into adjacent territory. O.

ALLIANCE, NEB.—The Reeves Telephone Company will build a line to connect with the Alliance exchange of the Nebraska Telephone Company. Charles Reeves is secretary and Charles Nepper, president. C.

EGG HARBOR CITY, N. J.—The Board of Public Utility Commissioners has granted the Egg Harbor City Telephone Company permission to issue stock for $2,000 for new construction work. A.

HADDONFIELD, N. J.—The Borough Council has granted the Delaware & Atlantic Telegraph & Telephone Company a franchise to install an underground conduit system throughout the town. A.

KELLOGG, IDAHO.—W. H. Conlin, Manager of the North Idaho Telephone Company, is authority for the statement that his company will extend its service into the territory recently settled in the Deadwood Gulch district. O.

BISBEE, ARIZ.—It is reported that the Mountain States Telephone Company is preparing to extend its system in the northern part of the state, one of the first lines to be increased being that between Tucson and Benson.

TIMBER LAKE, S. D.—F. E. Sexton, of Timber Lake, president of the Independent Telephone Company, is working for the establishment of a new telephone line between the agency and Timber Lake, via La Plant and White Horse. C.

SHERIDAN, ORE.—The Portland, Eugene & Eastern Railway Company, owners of the Sheridan & Willamina road, will build a telegraph line from Sheridan to Willamina within a short time, and will install a regular telegraph office at that point. O.

LONG BRANCH, N. J.—The New York Telephone Company has been granted permission by the Board of Public Utility Commissioners to install lines in West Long Branch and Lavallette, in accord with ordinances recently granted by these municipalities. A.

COLVILLE, WASH.—The Little Pend O'Reille Telephone Company has been organized for the purpose of building 27 miles of line from Colville to the Pend O'Reille Lakes. J. S. Gnagy is president of the company; Ed Fisher, vice-president, and A. E. Batman, secretary. Work will be started soon and completed by fall.

JERSEY CITY, N. J.—The Metropolitan Telegraph & Telephone Company has been incorporated with a capital stock of $300,000, to install and operate long-distance telephone and telegraph lines. The incorporators are Charles Borland, who is president; W. Lee Sellers, vice-president; Butler Jack, secretary; and Lee Lenon, general manager. A.

CLEVELAND, O.—Within the next few weeks the Cuvahoga Telephone Company will spend $125,000 improving service in and around Cleveland. The Company will enlarge its Union exchange to accommodate 600 new telephones at a cost of about $25,000 and change its 550 phones in Chagrin Falls from the magneto type with hand bell to the common battery type, at a cost of $42,000. All of the improvements planned by the company will provide facilities for 2,000 more telephones in Cleveland and the neighborhood. Charles A. Otis is president.

ELECTRIC RAILWAYS.

(Special Correspondence.)

AKRON, O.—The Northern Ohio Traction & Light Company is planning to extend its line. Address A. B. DuPont for information.

OMAHA, NEB.—It is said that the Omaha Commercial Club is interested in a proposed electric railway to run between Omaha and St. Joseph, Mo.

FOREST GROVE, ORE.—It is reported that the Oregon Electric Railway Company plans extending its line from this city to Gale Creek, and eventually to Tillamook. Q.

SEA GIRT, N. J.—The Atlantic Coast Electric Railway of Asbury Park, will build a new double-track line through the camp grounds here. S. F. Hazelrigg is president. A.

ROME, GA.—The Rome Railway, Light & Power Company is preparing to build two miles of additional traction line. S. S. Bush, of Louisville, Ky., is manager of the property. G.

JACKSONVILLE, FLA.—An electric railway connecting Jacksonville and Jacksonville Heights is under consideration. The Jacksonville Heights Company will contribute $25,000 toward building the line.

NEW ORLEANS, LA.—It is said that A. Smith Bowman, president of the Belleview Farms Company, is interested in a proposition to build an electric interurban line connecting New Orleans with Kennerville.

TAYLORVILLE, ILL.—The City Council has granted a 50-year franchise to the Decatur, Sullivan & Mattoon Transit Company to construct and operate an interurban railway over certain streets in Taylorville. Z.

SAN DIEGO, CAL.—It is reported that John B. Spreckels will extend the Ocean Beach electric car line from a point just beyond Loma Portal through Mossville and La Playa to Fort Rosecrans Military Reservation.

FRESNO, CAL.—As soon as the right-of-way deeds can be cleared the Fresno Traction Company will start construction of a railroad line from Muscatel to Biola, according to an announcement made by F. W. Webster, general manager.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will build an electric power line to Lewisburg, Kimberly and thence to Sibleyville, at an estimated cost of $50,000. The total distance is about 30 miles.

HARRISBURG, PA.—The Mount Bethel Street Railway Company and The Bangor & Portland Traction Company, of East Bangor, have filed the necessary papers announcing their merger. The new company has a combined capital of $130,000. N.

PORT TOWNSEND, WASH.—The Commercial Club here recently received word from Dr. W. B. Webb, who has a franchise for building and operating a street-car system in this city, that work of constructing the line will be started next month. O.

MERRILL, WIS.—The Minneapolis, Merrill & Marinette Railway Company has been incorporated with a capital stock of $400,000. It proposes to build a line from Merrill to Antigo, and Merrill to Prentice Junction. Address F. W. Kubasta, Merrill.

PUYALLUP, WASH.—The Puget Sound Traction, Light & Power Company contemplates extending the Short Line now owned and operated by this Company from this city to Summer, thence to Bluff, where it will join the main line to Seattle. O.

SYRACUSE, N. Y.—It has been announced that preliminary surveys have bave been made for the Ithaca-Cortland railway extension to Syracuse. It is said that the road will be built by a Philadelphia syndicate which has valuable traction holdings in Central New York.

OTTAWA, CAN.—There are plans under way for two important electric railways in Western Ontario. One is for 35 miles of the Erie, London & Tillsonburg Railway Company and the other for the Tillsonburg, Lake Erie & Pacific Railway Company from Ingersoll to Embro, a distance of about 10 miles.

ALBANY, ORE.—Engineer McClymonds, of the Portland, Eugene & Eastern Electric Railway, is authority for the statement that an electric line will be constructed from this city to Independence, by the company which he represents. Surveyors and engineering corps are now running lines between Albany and Independence. O.

MINNEAPOLIS, MINN.—According to reports current, in which E. G. Potter, president of the Minneapolis & Northern road, is named as principal, plans for another suburban electric line to link Minneapolis and St. Cloud are being worked out. This would make the fifth suburban railway company with Minneapolis headquarters. The new line would run through a thickly settled and prosperous territory.

SACRAMENTO, CAL.—As soon as the Colusa branch of the Northern Electric Railway is turned over to the operating department, the construction department will turn its attention to the lines between Sacramento and Vallejo. The first work to be done will be to complete the ten-mile line between Vacaville and Suisun and then all energies will be turned toward the completion of the direct line between Vallejo and Sacramento, a distance of 60 miles.

BILLINGS, MONT.—The plat of the proposed electric line from Billings to Gardiner, by way of the Clark Fork Valley and Cooke City, has been filed in the local land office. The project is backed by New York capitalists and surveys have been completed as far as Cooke City. The proposed line, which is called the Eastern Montana Electric Railway, is 62 miles long, and it is intended to equip it for the transportation of both freight and passengers. An organization was perfected locally last year headed by A. C. Logan, president.

PORTLAND, ORE.—An electric railway service that will cover the entire coast, from Portland, Ore., to San Diego, Cal., before the opening of the Panama Pacific Exposition in San Francisco in 1915, is the reported plan of the Southern Pacific subsidiary electric system. This condition, it is said, will result from the unmerging of the Pacific Electric Company and the Peninsular Electric and other lines, that have been part of the Southern Pacific system. The Southern Pacific has acquired water-power routes from Portland to Eugene, Ore., and has made extensions into Klamath Falls that will soon be electrified. O.

NEW INCORPORATIONS.

ELMIRA, N. Y.—The O'Shea-Wright Electric Corporation has filed articles of incorporation, capitalized at $5,000. The company is formed to do a general electrical business. The incorporators are Davis S. O'Shea, Charles O. Wright, Frank W. Wright, this city.

MORRISTOWN, N. Y.—Gregory Electric Company, Incorporated, has been incorporated with a capital stock of $4,000 for the purpose of manufacturing and using electricity. The incorporators are Arthur W. Gregory, Edna M. Gregory and A. Sophia Gregory, all of Morristown.

OKLAHOMA CITY, OKLA.—The Public Service Corporation of Oklahoma, with a capital stock of $3,000,000, has been granted a charter for the purpose of operating gas and electrical plants, street railways, etc. H. L. McCracken, C. Sullivan, A. E. Johnson, E. J. Cliggett and John Rapp are the incorporators.

NEW YORK, N. Y.—Doll & Sinclair, Incorporated, has filed articles of incorporation with a capitalization of $1,000 for the purpose of engaging in a general electrical business. The incorporators are John T. Sinclair, Bayside, N. Y.; Clarence E. Doll and Robert P. Schur, both of New York City.

NEW PUBLICATIONS.

MAGNETIC IRON SANDS.—The Canadian Department of Mines has issued a report on the magnetic iron sands of Natashkwan, Que., by George C. Mackenzie. This is a comprehensive bulletin of 57 pages containing many maps, diagrams and half-tone illustrations.

THE SLIDE RULE IN PHOTOMETRY.—The Electrotechnical Laboratory, Tokio, Japan, has issued report No. 14 entitled "On the Calculating Rule for Illumination and Photometric Measurement," by T. Hirobe and R. Mitzuda. This explains the use of the slide rule in illumination and photometric calculations.

MINERAL PRODUCTION OF CANADA.—The Canadian Department of Mines has issued its annual report on the mineral production of Canada during the calendar year 1911, by John McLeish. This covers not only the metallic ores, but such non-metallic products as asbestos, coal, mica, petroleum and salt, and various structural materials and clay products.

THE TUNGSTEN LAMP AND RADIO ENGINEERING.—The first issue of the new series of the *Transactions* of the New York Electrical Society contains two addresses which were delivered before the Society entitled "The Chemistry of Tungstcn and Evolution of the Tungsten Lamp," by Charles Baskerville, and "Radio Engineering at the College of the City of New York," by Alfred N. Goldsmith.

INCANDESCENT LAMP AND LIGHTING SERVICE.—The paper presented at the convention of the National Electric Light Association by Robert E. Campbell and M. D. Cooper entitled "The Relation of the Incandescent Lamp to Lighting Service" has been reprinted by the National Quality Lamp Division of General Electric Company, and is being distributed to those interested. An abstract of this paper will be found in our last issue.

FINANCIAL NOTES.

The gross receipts of the Massachusetts Electric Companies for May gained $22,000, or three per cent over same month a year ago.

The Montreal Light, Heat & Power Company at a special meeting of stockholders authorized an increase in capitalization of $5,000,000, raising the total from $17,000,000 to $22,000,000. Of the new stock is was decided to issue $1,700,000 to shareholders and $100,000 to employees at par. The first payment on the new issue to shareholders will not be called before November, 1913.

At a meeting of directors of the Columbia Gas & Electric Company an issue of $3,000,000 five-per-cent debenture bonds was authorized, the proceeds to be used in acquiring the outstanding preferred and common stock and scrip of the Union Gas & Electric Company, an underlying corporation. The debentures will be exchanged par for par for the preferred stock of the Union Gas & Electric Company, of which there is outstanding $5,000,000, of which the Columbia Gas & Electric Company already owns 60 per cent; par for par for the $350,000 six-per-cent dividend scrip issued for payment of dividends on preferred stock and due July 1, 1914, and in the ratio of one $100 debenture for each ten shares of Union Gas & Electric common, of which $10,000,000 has been issued, 56 per cent of which is owned by the Columbia Gas & Electric Company.

Dividends.

Arkansas Valley Railway Light & Power Company, quarterly dividend of 1.75 per cent on preferred, payable June 16 to stock of record May 31.

California Railway & Power Company, the regular quarterly dividend of 1.75 per cent on its prior preference stock, payable July 1 to stock of record June 21.

Canadian General Electric Company; a quarterly dividend of 1.75 per cent, payable July 1 to stock of record June 14.

Eastern Power & Light Corporation; initial quarterly dividend of 1.5 per cent on preferred, payable June 15.

General Gas & Electric Company; a preferred quarterly dividend of 1.5 per cent, payable July 1 to stock of record June 20.

Indianapolis Street Railway Company, semi-annual dividend of three per cent, payable July 1.

Interborough Rapid Transit Company; the regular quarterly dividend of 2.5 per cent, payable July 1 to stock of record June 23.

Lake Shore Electric Railway; a quarterly first-preferred dividend of 1.5 per cent, payable July 1.

Manhattan Railway Company; the regular quarterly dividend of 1.75 per cent, payable July 1 to stock of record June 16.

Manila Electric Railroad & Lighting Corporation; regular quarterly dividend of 1.75 per cent, payable July 1 to stock of record June 18.

Montana Power Company, a quarterly common dividend of 0.5 per cent, and preferred dividend of 1.75 per cent, both payable July 1.

Muskogee Gas & Electric Company; quarterly dividend of 1.75 per cent on preferred, payable June 16 to stock of record May 31.

Narragansett Electric Lighting Company; regular quarterly dividend of $1 a share, payable July 1 to stock of record June 10.

New York State Railways; regular quarterly dividend of 1.25 per cent, on the preferred and 1.5 per cent on the common stock, payable July 1 to stock of record June 17.

Niagara Falls Power Company; a quarterly dividend of $2 per share, payable July 15.

St. Joseph Railway, Light, Heat and Power Company; quarterly dividend of 1.25 per cent on the preferred stock, payable July 1 to stock of record June 14.

Toronto Railway Company; regular quarterly of two per cent, payable July 2 to stock of record June 16.

Union Traction Company; a semi-annual dividend of $1.50 per share, payable July 1 to stock of record June 9.

United Traction & Electric Company; quarterly dividend of 1.25 per cent, payable July 1 to stock of record June 10.

West End Street Railway Company; semi-annual dividend of $2 on preferred, payable July 1.

Western Electric Company; the regular quarterly dividend of two per cent, payable June 30 to stock of record June 23.

Reports of Earnings.

PACIFIC LIGHT AND POWER.

The Pacific Light & Power Company, in its report for March and the first quarter of 1913, shows that the company earned the interest on the $10,000,000 refunding bonds and $2,500,000 notes, although these items are charged to construction at present. The balance after interest increases 51.4 per cent during the month, and 64.1 per cent during the quarter. The report of the company is as follows:

Month of March—	1913	1912
Gross earnings	$213,463	$192,099
Oper. expenses and taxes	118,724	115,257
Net earnings	$94,739	$76,572
Other income	9,172	4,848
Total income	$103,911	$81,420
Interest	39,529	38,898
Balance	$64,382	$42,522
Three months ended March 31—		
Gross earnings	$647,667	$585,921
Oper. expenses and taxes	367,714	351,863
Net earnings	$279,952	$234,056
Other income	28,654	8,741
Total income	$308,607	$242,799
Interest	118,132	126,792
Balance	$190,475	$116,007

E. W. CLARK & COMPANY PROPERTIES.

The following companies under supervision of E. W. Clark & Company report earnings for April, 1913, and the twelve months ended April 30, 1913:

BANGOR (ME.) RAILWAY & ELECTRIC.

	1913	1912
April gross	$57,448	$51,492
Net after taxes	29,894	26,837
Surplus after charges	12,763	10,345
Twelve months' gross	730,006	631,572
Net after taxes	399,835	339,533
Surplus after charges	196,245	169,169
Balance after preferred dividends	91,245	64,169

CONSUMERS POWER COMPANY OF MICHIGAN.

	1913	1912
April gross	$253,532	$215,813
Net after taxes	131,034	100,270
Surplus after charges	71,575	53,339
Twelve months' gross	2,937,798	2,487,153
Net after taxes	1,403,569	1,159,699
Surplus after charges	722,495	635,477
Balance after preferred dividends	443,995	395,477

CUMBERLAND COUNTY (ME.) POWER & LIGHT.

	1913	1912
April gross	$167,748	$156,756
Net after taxes	69,195	62,949
Surplus after charges	12,323	10,231
Twelve months' gross	2,189,830	2,058,270
Net after taxes	970,218	795,367
Surplus after charges	304,458	206,685
Balance after preferred dividends	202,458	184,185

GRAND RAPIDS (MICH.) RAILWAYS COMPANY.

	1913	1912
April gross	$100,108	$94,339
Net after taxes	39,800	39,148
Surplus after charges	24,790	24,632
Twelve months' gross	1,254,600	1,197,830
Net after taxes	536,853	523,426
Surplus after charges	360,629	345,733
Balance after preferred dividends	285,629	270,733

LEWISTON, AUGUSTA & WATERVILLE STREET RAILWAY.

	1913	1912
April gross	$49,274	$45,045
Net after taxes	16,850	15,530
Surplus after charges	2,191	1,084
Twelve months' gross	641,473	602,693
Net after taxes	248,440	225,832
Surplus after charges	74,932	54,662
Balance after preferred dividends	38,932	18,662

PORTLAND (ME.) RAILROAD COMPANY.

	1913	1912
April gross	$74,793	$70,472
Net after taxes	16,584	16,092
Surplus after charges	6,286	5,886
Twelve months' gross	1,001,573	968,238
Net after taxes	298,970	249,430
Surplus after charges	175,498	134,315

SAN JOAQUIN LIGHT AND POWER COMPANY.

The San Joaquin Light & Power Corporation has reported for April and four months, the balance after interest for both the month and the period showing big gains over 1912. During the first four months of the year the company earned one and one-half times its dividend on the $6,500,000 six-per-cent preferred stock, while the net earnings were about two and one-half times interest charges. The report of the company is as follows:

Month ended April 30—	1912	1913
Gross income	$107,974.09	$142,203.35
Operating expenses, maintenance & taxes	41,481.12	59,562.28
Net income	$66,492.97	$82,641.07
Interest charges	31,012.34	33,493.75
Balance	$35,480.63	$49,147.32
Four months ended April 30—		
Gross income	$417,534.82	$548,564.86
Operating expenses, maintenance & taxes	176,696.82	217,727.95
Net income	$240,838.00	$330,836.91
Interest charges	126,801.17	133,159.62
Balance	$114,036.83	$197,677.29

CLOSING BID PRICES FOR ELECTRICAL SECURITIES OF THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	June 9	June 2
American Tel. & Tel. (New York)	127½	129¼
Commonwealth Edison (Chicago)	*131	131
Edison Electric Illuminating (Boston)	255	265
Electric Storage Battery common (Philadelphia)	45	47¼
Electric Storage Battery preferred (Philadelphia)	45	47¼
General Electric (New York)	134	136
Kings County Electric (New York)	129	129
Manhattan Transit (New York)	1⅝	1½
Massachusetts Electric common (Boston)	13½	14¾
Massachusetts Electric preferred (Boston)	69	73
National Carbon common (Chicago)	*116½	116½
National Carbon preferred (Chicago)	*115	115
New England Telephone (Boston)	142½	142½
Philadelphia Electric (Philadelphia)	21½	22½
Postal Telegraph and Cables common (New York)	79	81
Postal Telegraph and Cables preferred (New York)	66	67
Western Union (New York)	60	65¼
Westinghouse common (New York)	58	61½
Westinghouse preferred (New York)	104	109¾

*Last price quoted.

PERSONAL MENTION.

ROBERT E. RAE has become associated with Stanley & Patterson, Incorporated, of New York, as sales manager of their factory lines.

F. D. PHILLIPS, formerly city sales manager of the Wesco Supply Company, St. Louis, Mo., has been made general sales manager of the company.

GEORGE F. SWAIN has been chosen chairman of the Boston Transit Commission, which has charge of the construction and maintenance of subways in that city. He succeeds the late George S. Crocker.

THOMAS H. SHAUGHNESSY, master mechanic of the Essex Division of the Public Service Railway Company, Newark, N. J., has resigned to become superintendent of the Chicago Railways, Chicago.

J. M. CULVER has resigned his position with the Fulton (Ky.) Light & Power Company to become head of the Culver Ice Cream Company, which will put a large factory in operation in Fulton.

W. L. HEFFNER, representing H. W. McCandless & Company, New York, manufacturers of miniature electric lamps, has been in Chicago for several weeks and reports business excellent all through that territory.

CRUSE CARRIEL, manager of the retail sales department of the Public Service Company of Northern Illinois, left Saturday, June 7, for an extended trip through the west, and he will visit Pacific Coast points before returning east.

SAMUEL BARNES, formerly associated with the Cape Girardeau & Jackson Interurban Railroad Company, Cape Girardeau, Mo., has been appointed superintendent of the Jersey Central Traction Company, with offices at Keyport, N. J., succeeding A. H. Mann, resigned.

WILLIAM C. CAMPBELL, who for the last five years has handled the eastern business of the Steel City Electric Company of Pittsburgh, under the firm of the Campbell-Stagg Company, announces that he is no longer connected with the Steel City Company. The Campbell-Stagg Company will continue in business as heretofore.

ARTHUR WILLIAMS, president of the American Museum of Safety, was among the passengers who sailed on Thursday, June 5, on the *France*. He will visit the well known museums of safety abroad, to study how the European employers are cutting their accident and death rate in industry. The results of his trip will form a noteworthy feature of the First International Exposition of Safety and Industrial Hygiene held in America, which will take place in New York City toward the end of 1913.

J. M. BISSELL, for the past year and a half assistant treasurer of the Paducah (Ky.) Light & Power Company, a Stone & Webster property, has been promoted to the post of assistant treasurer with the Mississippi River Power Company, which has just put its hydroelectric plant at Keokuk, Iowa, in operation. The change is considered a big advance for Mr. Bissell, whose work has been high-class. He is to be succeeded in Paducah by F. B. FLAHIVE, who has been located at Dallas, Tex. The change is effective June 15.

C. H. BAKER has been appointed mechanical engineer of the Public Service Electric Company, Newark, N. J., taking effect June 1. Mr. Baker graduated from Lawrence Scientific School in 1902, since which time he has been identified with Westinghouse, Church, Kerr & Company as construction engineer; Brooklyn Rapid Transit Company as power station inspection engineer; New York, New Haven & Hartford Railroad as assistant chief engineer of its Cos Cob plant, and the New York, New Haven & Hartford as chief engineer of the Hoosac Tunnel power station of the Boston & Maine Railroad and Berkshire Street Railroad.

HENRY L. DOHERTY, who returned from Europe on the steamship Kronprinzessin Cecilie on Tuesday, said that the financial and investment situation on the other side during the last few months had undergone an entire change. The time no longer exists, he said, when companies desiring to do new financing may dispose of securities on a low interest bearing basis, and the sooner this condition of affairs is realized the quicker the entire financial situation will assume a more normal aspect. He referred to the failure of a number of offerings in London during the last few weeks, mentioning the Brazilian loan of $55,000,000, of which only six per cent was taken. While in London Mr. Doherty placed $3,000,000 Cities Service Company five-year seven-per cent notes with investors, and the remainder of the issue, amounting to $2,000,000, he said, would soon be brought out in this country at par. Details for the conclusion of the new financing will be worked out and the public offering of the issue will probably be made in the near future. Mr. Doherty said that he personally was responsible for the high rate of interest on these notes, because he fully realized that the public would not absorb securities except on an attractive basis.

OBITUARY.

ROBERT J. DALEY, superintendent of the Pittsburgh Bureau of Electricity, died on the evening of June 2, at his home in Pittsburgh, from valvular heart trouble. He had been ill for about a week. He was appointed head of the Bureau of Electricity some years ago, having previously been associated with the Allegheny County Light Company, the Postal Telegraph Company, the Home Telephone Company and the Pittsburgh Board of Underwriters. Mr. Daley was born in Elyria, O., and went to Pittsburgh when a young man. He is survived by four children, five sisters and one brother.

PROPOSALS.

CONDUIT AND WIRING SYSTEM.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until June 26, for a conduit and wiring system, gas piping, lighting fixtures, etc., in the post office at Marquette, Mich.

ELECTRICAL APPARATUS.—Sealed proposals will be received at the Bureau of Purchases of the Board of Education, 730 Tribune Building, Chicago, Ill., for electrical apparatus and supplies for the Electrical Department of the Hyde Park High School. The Board may be addressed for further information.

LIGHTING SYSTEM.—Sealed proposals indorsed "Proposals for Electrical Distribution System," will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 12, for installing an electrical distribution and street lighting system at the naval hospital, Chelsea, Mass., at an estimated cost of $4,000.

ELECTRIC ELEVATORS.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until June 17, for two electric passenger elevators in the post office at Philadelphia, Pa., in accordance with drawing and specification.

ELECTRICAL SUPPLIES.—Sealed proposals will be received by Ray Palmer, city electrician, Room 614 City Hall, Chicago, Ill., until June 19 for furnishing 6,000 feet of five-pair cable; 9,220 feet of 15-pair cable; 12,500 feet of 30-pair cable; 1,200 feet of 50-pair cable, and until June 20 for furnishing and delivering to the Department of Electricity, Chicago, Ill., electrical supplies strictly in accordance with specifications on file in the city electrician's office.

ELECTRIC MACHINE TOOLS.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., on June 24, for furnishing one electric, three-motor traveling crane, as per Schedule 5.538; one electric 10-ton gantry crane, as per Schedule 5.540, to be delivered at the Navy Yard, Brooklyn, N. Y.; and one gate shear complete with motor drive, as per Schedule 5.539, to be delivered at the Navy Yard, Charleston, S. C.

ELECTRICAL APPARATUS.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 24, for furnishing 3,500 feet of electric insulated cable, as per Schedule 5.549, to be delivered at the Navy Yard at Portsmouth, N. H.; for one alternating-current generator, one direct-current oil-engine-driven exciter unit, one switchboard for power and lighting plant and one motor-generator set, as per Schedule 5.532, to be delivered at the Naval Experiment Station, Annapolis, Md.

ELECTRIC CONDUIT AND WIRING AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until July 2, for furnishing the electric conduit and wiring and interior lighting fixtures of a two-story building for the post office at Springfield, Tenn.; until July 7, of a three-story building for the post office at Bangor, Me.; until July 8, of a one-story building for the post office at Searcy, Ark.; until July 10, of a one-story building for the post office at New Bedford, Mass.; until July 11, of a one-story building for the post office at Greenville, N. C.; until July 15, of a one-story building for the post office at Poplar Bluff, Mo.; and until July 16, of a two-story building for the post office at Corry, Pa. Copies of drawings and specifications may be obtained from the custodians of the sites or from the office of the Supervising Architect.

DATES AHEAD.

Association of Railway Electrical Engineers. Semi-annual convention, Atlantic City, N. J., June 16.

Electrical Contractors' Association of the State of Illinois. Semi-annual meeting, Hotel Sherman, Chicago, Ill., June 20 and 21.

American Institute of Electrical Engineers. Thirtieth annual convention, Hotel Otesaga, Cooperstown, N. J., June 23-27.

Society for the Promotion of Engineering Education. Annual convention, Minneapolis, Minn., June 24-26.

Canadian Electrical Association. Annual convention, Toronto, Ont., June 25-27.

American Institute of Chemical Engineers. Sixth semi-annual meeting, Boston, Mass., June 25-28.

Electrical Contractors' Association of the State of Missouri. Annual meeting, St. Louis, Mo., July 12.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 15-18.

National Electrical Contractors' Association. Annual meeting, Chattanooga, Tenn., July 16-19.

Association of Edison Illuminating Companies. Annual convention, Cooperstown, N. Y., September 8-11.

American Electrochemical Society. Annual meeting, Denver, Colo., September 9-11.

Northwest Electric Light and Power Association. Annual convention, Seattle, Wash., September 10-12.

Pennsylvania Section, National Electric Light Association. Annual convention, Delaware Water Gap, Pa., September 16-18.

With the Electrical Manufacturers

Hemming Manufacturing Company, Garfield, N. J., announces the receipt of an order from the United States Navy Department for the supply of a number of dies and a quantity of heat-resisting molded insulation for use in various navy yards. The company is much gratified by this indorsement of its products by the naval authorities.

Appleton Electric Company, Chicago, Ill., has issued a complete booklet describing and listing its line of wattmeter boxes from 1 to 30, 31 to 60 and 65 to 100 amperes. These boxes are approved by the National Board of Fire Underwriters, and are also approved and used by the City of Chicago Inspection Department in apartment, store and office buildings.

George J. Henry, Jr., Rialto Building, San Francisco, Cal., has sent out cards showing several views of the water wheels he designed for the Los Angeles power project. In his work as designing and constructing engineer he makes a specialty of complete hydraulic plants, and hydraulic specialties under the Henry patents for tangential water wheels, Francis turbines, governors, relief valves, etc.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., contrary to its usual practice, did not have an exhibit at the convention of the National Electric Light Association last week. There was quite a contingent of representatives present, however, and among those in evidence were J. W. Gardner, J. R. Jeffert, R. E. Williamson, W. H. Powell, L. E. Bogen, L. A. Phillips, W. M. White, E. T. Pardee, E. A. Quinn and representatives of the Chicago office.

Holophane Works of the General Electric Company, Cleveland, O., has issued Bulletin 106 which deals with semi-indirect bowls and other ornamental glassware. It shows a number of handsome designs of Veluria and Calla bowls and a considerable number of shades, all of them of very artistic patterns. In some of these not only is the general shape of graceful proportions but the surface is attractively etched with a decorative pattern. The bulletin gives data and prices on this glassware.

The American Brass Company, Ansonia, Conn., has issued a pamphlet dealing with Tobin bronze. This describes the physical and chemical properties of the alloy, among which are noncorrodibility, great crushing, tensile and torsional strength; this material is suitable for piston rods, plungers, valve stems and faces, linings for pumps, box bushings, condenser tube plates, drop forgings, bolts, screws, etc. The bulletin shows and describes the use of this metal for yacht construction, for which it seems also to be peculiarly adapted.

Walker Brothers & Haviland, New York City, have issued a bulletin describing Monarch electric synchronized time systems. The bulletin is divided into two parts, the first describing synchronized clock systems, comprising master and secondary clocks for use in large buildings and institutions of various kinds. The second part of the bulletin is devoted to complete synchronized time systems and describes synchronized apparatus of all kinds, such as time recorders, time stamps, program clocks, etc., for the use of offices, factories, hotels, etc. The bulletin is very copiously illustrated.

Spray Engineering Company, Boston, Mass., has published bulletin No. 51; this is devoted to air washers for cleansing ventilating air for rooms that must be supplied with air absolutely free from dust and dirt. This is done in the same way as rain washes the atmosphere. A special atomizing spray nozzle is made by the company for this purpose. Its construction and action is explained in the bulletin, also the general arrangement of the entire apparatus, which consists of a motor-driven circulating pump, screen and auxiliary sprays, eliminator plates, water screen, etc., all compactly arranged.

The Robbins & Myers Company, Springfield, Ohio, manufacturer of the Standard power motors, generators and electric fans, announces the opening of two new branch sales offices. One is at Cincinnati, Ohio, in charge of G. H. Liebel and located at 608 First National Bank Building; Mr. Liebel will look after sales of Robbins & Myers motors and generators in Cincinnati, Louisville and contiguous territory. The other branch is at 369 Spitzer Building, Toledo, Ohio, where E. A. Williams will make his headquarters and will have charge of sales in the territory of northwestern Ohio, southern Michigan including Detroit, and northeastern Indiana.

Automatic Electric Company, Chicago, Ill., has issued the first number of a monthly publication entitled *Automatic Telephone,* which it will issue henceforth in newspaper form. It is printed on excellent paper and contains much of interest to those with a leaning toward automatic telephony. Among special articles are the first installments of two series written by Bernard C. Groh and Roy Owens, dealing with development studies and scientific management of telephone exchanges. The progress of automatic telephony throughout the world is told in another article. Many interesting incidents are narrated showing the superiority of the automatic telephone over the older type involving manual operation.

General Electric Company, Schenectady, N. Y., has issued some new and interesting publications. Bulletin No A4035 describes series luminous arc lamps of the magnetite type. These lamps are made for 4 and 6.6-ampere direct-current circuits. The bulletin points out their superiority over the older open and inclosed arcs, shows lamp parts, distribution curves, wiring and dimension diagrams and many typical street scenes.—Bulletin A4114 gives information on type F, form K21 central-station oil switches made for voltages up to 45,000. The construction of these switches and auxiliary relays is described in some detail and their method of operation explained. A similar bulletin on switches of the same type for all voltages up to 110,000 is in preparation.—Bulletin A4109 covers belt-driven revolving-armature alternators and brings the information on these machines up to date.—Bulletin A4122 supersedes an earlier publication on carrier-bus arc panels for Brush arc-lighting machines.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.,

reports the following among important orders recently received: St. Petersburg Investment Company, St. Petersburg, Fla., one 500-kilowatt, 60-cycle, 600-volt railway rotary converter, a 550-kilowatt transformer, and one three-panel switchboard. Greenville, Spartansburg & Anderson Railway Company, Charlotte, N. C., one 300-kilowatt, 66.7-cycle, 600-volt, rotary converter with three 100-kilowatt, 20,800 to rotary voltage transformers, and switchboard. Centerville Light & Traction Company, Centerville, Ia., two 100-kilowatt, motor-generator sets each consisting of 275-volt direct-current generator and three-phase, 60-cycle, 2,200-volt, self-starting synchronous motor with exciter; also a similar set of 175 kilowatts, and four transformers and auto starters for the same. Pittsburgh, Harmony, Butler & New Castle Railway Company, Pittsburgh, Pa., two 250-kilowatt, 60-cycle, 600-volt rotary converters to be built on one bedplate and to operate as one 500-kilowatt, 1,200-volt, direct-current rotary; one 550-kilowatt, 13,200 - to - rotary - voltage transformer, and one complete switchboard for the above.

Record of Electrical Patents.

Issued by the United States Patent Office, June 3, 1913.

1,063,179. Protecting Electric Motors. G. A. Burnham, assignor to S. B. Condit, Jr., Brookline, Mass. Includes overload and underload relays for the circuit-breaker.

1,063,181. Tabulating Mechanism. J. J. Chapin, assignor to Burroughs Adding Machine Co., Detroit, Mich. Is operated by an electric motor.

1,063,182. Trolley-Wire Hanger. J. Christensen, Evans City, Pa. Is of arch construction with the hanger wire clamped under the arch.

1,063,193. Combined Telegraph and Signaling System. E. R. Gill, assignor to General Railway Equipment Co. Provides for multiplex telegraphy and includes a signaling selector.

1,063,206. Third-Rail Electric-Railway System. M. M. Marx, New York, N. Y. A sectional third rail with a switch at the beginning of each section controlled by a plunger on the car.

1,063,237. Welded Receiver. V. Anderson, assignor to Western Electric Co. The pole piece is welded to the magnet.

1,063,249. Protector. P. E. Erikson, assignor to Western Electric Co. Includes two discharge plates, one of copper, and the other of an alloy of copper, with a thin insulating sheet between them.

1,063,259. Magnetic Wheel. J. O. Heinze, Jr., Detroit, Mich. Has a magnetizing coil around the hub; the tread portion of the wheel consists of iron parts separated by a nonmagnetic section.

1,063,265. Electric Service Board. N. Joleen, Chicago, Ill. A panelboard is arranged in a cabinet, the walls of which can be separately removed.

1,063,270. Welded Receiver. J. J. Lyng, assignor to Western Electric Co. A modification of No. 1,063,237.

1,063,272. Time-Recording Register. H. B. McCabe, assignor to Gisholt Machine Co., Madison, Wis. An electromagnetically operated time stamp.

1,063,280. Process of Producing Low-Carbon Ferro-Alloys. J. M. Morehead, assignor to Electro Metallurgical Co., Chicago, Ill. Consists in electrically smelting an alloy with carbon and an iron compound and further electrically heating the combination.

1,063,303. Electrical Resistance. E. Thomson, assignor to General Electric Co. Consists of a number of plates of material having properties similar to boron.

1,063,325. Railroad Signal. A. William Bower, Derby, Colo. An electromagnetically operated semaphore.

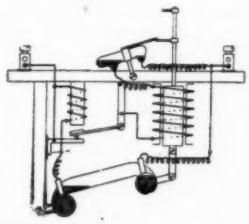
1,063,341. Process of Producing Low-Carbon Ferro-Alloys. I. R. Edmands, assignor to Electro Metallurgical Co. A modification of No. 1,063,280.

1,063,357. Process of Electric Welding. M. Lachman, assignor to Standard Pulley Manufacturing Co. For forming angle or T welds.

1,063,361. Telephone System. O. M. Leich, assignor to Cracraft, Leich Electric Co., Genoa, Ill. Relates to special features of the trunking circuit.

1,063,369. Circuit-Controlling Thermostat. J. F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Co. Includes electromagnetic control and a motor-driven switch for the heating circuit.

1,063,377. System of Electric Motor Control. C. H. Norwood, Chicago, Ill. Includes two motors with electromagnetic control for governing them in sequence and together.



1,063,557.—Mercury-Lamp Tilter.

1,063,392. Gas-Lighter. J. K. Rush, Syracuse, N. Y. Has an electric ignition device.

1,063,396. Means for Increasing the Speed of Transmission of Signals Over Telegraph and Cable Lines. G. Seibt, New York, N. Y. Artificial leakage paths are connected to the wire so as to be closest together at the middle portion thereof.

1,063,400. System of Electric-Motor Control. T. Varney, assignor to Westinghouse Electric & Mfg. Co. Two hoisting motors are connected in series in a local circuit while at rest, in parallel to the supply circuit while hoisting, in series for kick-off and in independent local circuits for braking.

1,063,401. Lamp for Picture-Display Machines. A. F. Victor, Davenport, Iowa. An incandescent lamp is mounted at the focus of one of two reflectors placed on front and back thereof.

1,063,416. Automatic Shoe - Shining Machine. A. A. Cook, assignor to National Electric Shoe Shining Machine Co., Pittsburgh, Pa. Electrically driven.

1,063,417. Process of Making Compound Hollow Metal Bodies. E. G. Cook, assignor to Brass & Copper Products Co., New York, N. Y. Consists in making a form of the proper shape, electrodepositing a coating of metal thereon, forming another body of plastic material upon this coating and electrodepositing a second metal coating upon this.

1,063,455. Sparking Device for Explosive Engines. W. S. Liming, Scranton, Pa. Special switch control for the ignition circuit.

1,063,483. Refractory Container. E. Weintraub, assignor to General Electric Co. In an electric furnace is a container consisting of boron nitride surrounded by an inert gas in a metal casing.

1,063,496. Electric Incandescent Lamp. E. G. Royer, assignor to Société Anonyme Oriona, Brussels, Belgium. Has two filaments arranged in two different horizontal planes.

1,063,501. Sleet-Scraper for Trolleys. M. J. Brennan, Tompkinsville, N. Y. The scraper is mounted upon the trolley wheel.

1,063,535. Electric Heating Device. W. S. Hadaway, Jr., New York, N. Y. At the end of a rotary roll is a hollow chamber containing the heating element.

1,063,541. Apparatus for Starting Multiple-Cylinder Internal-Combustion Engines. G. Honold, assignor to firm of Robert Bosch, Stuttgart, Germany. A special ignition circuit includes a buzzer, an interrupter in parallel therewith and independent circuit closers for each.

1,063,542. Electrical Ignition System for Internal-Combustion Engines. G. Honold, assignor to firm of Robert Bosch. Includes a battery common to both the primary and secondary circuits.

1,063,555. Electric Ignition System for Internal-Combustion Engines. F. Kratz, assignor to firm of Robert Bosch. Includes a mechanical interrupter.

1,063,556. Circuit-Controlling Device for Electric Ignition Systems. F. Kratz, assignor to firm of Robert Bosch. Combined with an ignition coil with a vibratory armature is a special push-button.

1,063,557. Shunt-Circuit Tilting Device for Mercury-Vapor Lamps. R. Küch, assignor to General Electric Co. The shunt circuit is opened on completion of the tilting motion but again closed in case the lamp tilts back to initial position.

1,063,591. Block-Signal System. W. B. Potter, assignor to Union Switch & Signal Co. Has polarized track relays at the ends of the block sections.

1,063,599. Telephone Register and Lock Out Device. C. V. Richey, Washington, D. C., assignor to Phone

Call Recorder Co. The register is actuated by ringing current on the line.

1,063,601. Antiseptic Mouthpiece for Telephone and Similar Instruments. M. Rosenwald, New York, N. Y., and J. C. Doran, Danbury, Conn., assignors to Frank A. Weeks Mfg. Co. A gauze is stretched across the diaphragm.

1,063,608. System of Regulation. E. T. Shaw and J. M. Naul, assignors to General Electric Co. Includes a motor with subdivided field winding; when the supply voltage is low a relay shunts one part of the field; when the voltage is high the shunt is opened.

1,063,614. Electric Heater. W. Stanley and H. M. Smith, assignors to General Electric Co. The bottom of the cup has a ring-shaped upwardly extending recess, into which the heating element is mounted.

1,063,623. Electropneumatic Brake. W. V. Turner, assignor to Westinghouse Air Brake Co., Pittsburgh, Pa. Has electric means for effecting service and emergency applications of the brakes.

1,063,631. Interlock for a Combined Car and Electric Coupling. H. H. Westinghouse, assignor to Westinghouse Air Brake Co. Includes means for coupling an electric train-line circuit and locking means controlled by this circuit for preventing release of the coupler.

1,063,646. Unreeling Device for Electric Conductors. A. Bournonville, Philadelphia, Pa. Twisted lamp cord and similar wire is specially reeled in a casing with a special lid.

1,063,650. Independent Standard for Supporting Dental Engines. A. W. Browne, assignor to S. S. White Dental Mfg. Co., Philadelphia, Pa. Includes a rheostat mounting, control box and means for supporting the motor-driven dental device.

1,063,651. Attachment for Magnetos. W. S. Burnett, assignor to Morse Code Signal Co., Milwaukee, Wis. Includes a circuit-closing brush connected with one pole of the armature.

1,063,668. Machine for Casting and Preparing Curved Stereotype-Plates. A. Egli, assignor to Vogtländische Maschinen-Fabrik (vormals J. C. & H. Dietrich) Actiengesellschaft, Plauen, Germany. Includes a motor-driven conveyor for delivering the molten metal to the mold and an electric clutch for connecting the conveyor and motor.

1,063,671. Aerial for Wireless-Telegraph Systems. H. L. Falk, assignor to Falk-McMahon Wireless Telegraph & Telephone Co., New Orleans, La. Consists of a frame with several receiving and transmitting members, each consisting of an open coil of wire having a straight length of wire axially extended within it, the axial wires being connected to ground.

1,063,691. Electric Signal for Railways. H. J. Jones and F. T. Jones, assignors to Jones Safety Train Control System Co., Baltimore, Md. Provides for electrical control of the air brake through a contact alongside the rail.

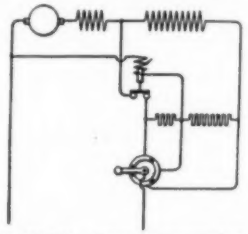
1,063,715. Trap. E. G. McCue, Sharpsburg, Pa. An electric rat trap.

1,063,741. Electric Safety Signal Device. J. A. Schellenger, Harrisburg, Ill. A signal system for mine shafts to serve as a protection for the operation of the cages.

1,063,760. Production of Long Stable Electric Arcs. J. Zenneck and K. Vollmer, assignors to Norsk Hydro Elektrisk Kvaelstofaktieselskab, Christiania, Norway. Consists in maintaining a current of the gas possessing a whirling motion around an arc which is subjected to the action of a magnetic field.

1,063,778. Photographer's Flashlight. J. L. Courson, Barberton, O. Provides for electric ignition of the flash powder.

1,063,804. Means for Cleaning Ships' Hulls. G. J. Kindermann, Wayville, So. Aus., Australia. Two motors, each enclosed in a casing, are connected by a shaft, about which is a cleaning roll.



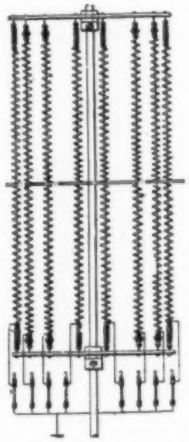
1,063,608.—Feeder Regulator.

1,063,824. Electric Heat-Engine. R. A. Mitchell and F. A. Emerick, Oil City, Pa. Has a heating chamber in which is an electric heating element intermittently actuated.

1,063,827. Feeder-Support. C. J. Mullin, New York, N. Y. A special gripping device between a section of the conduit and the pull box.

1,063,854. Push-Button Switch. C. A. Clark, assignor to Trumbull Electric Co., Plainville, Conn. Covers details of construction of a snap switch.

1,063,872. Malt Turning, Aerating, and Gathering Machine. J. Guehring, San Francisco, Cal. The machine is mounted on a traveling crane which is motor-driven and also has a separate motor for operating the machine.



1,063,671.—Aerial for Wireless Work.

1,063,893. Process for Magnetic Separation of Ores Out of Slimes. B. Schwerin, assignor to Gesellschaft für Elektro-Osmose M. B. H., Frankfort-on-the-Main, Germany. Consists in adding an electrolyte of a character opposite to that of the ore to be separated and then subjecting the slimes to magnetic separation.

1,063,940. Perforating Apparatus for Telegraphic Strips. E. Belin, Paris, France. Includes a set of signaling electromagnets, a number of punches operated thereby, and an electromagnetically operated tape-feeding device.

Patents That Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office) that expired June 9, 1913.

561,560. Electric Arc Lamp. S. Bergmann, New York, N. Y.

561,562. Arm-Rest for Telegraph Operators. E. L. Brownson and H. W. Goodro, Hinesburg, Vt.

561,565. Automatic Electrical Battery Cutout. H. W. Clelland and F. J. Madden, Wilkinsburg, Pa.

561,581. Electric Switch. Monroe Guett, Hartford, Conn.

561,588. Electric Switch. J. L. Hornig, St. Louis, Mo.

561,590. Armature for Dynamo-Electric Machines. F. P. Ide, Eau Claire, Wis.

561,593. Dynamo-Electric Generator. B. G. Lamme, Pittsburgh, Pa.

561,601. Register for Telephones. E. L. Morey, Portland, Ore.

561,619. Toll-Counter for Telephone Lines. G. P. Seligmann-Lui, Paris, France.

561,636. Form for Winding Armature Coils. J. A. Webber, Lynn, Mass.

561,653. Telegraph Relay. E. Butler, New York, N. Y.

561,657. Thermo-Electric Generator. H. B. Cox, Hartford, Conn.

561,699. Electric Motor. W. H. Cooley, Brockport, N. Y.

561,700. Electric Motor. W. H. Cooley, Brockport, N. Y.

561,711. Electric Meter. R. O. Hood, Danvers, Mass.

561,735. System of Electrical Distribution. C. P. Steinmetz, Lynn, Mass.

561,777. Electrical Apparatus for Controlling Motion of Cranes, etc. J. A. Essberger, and A. W. Geyer, Berlin, Germany.

561,803. Dynamo-Electric Machine. F. G. Mayer, Chicago, Ill.

561,810. Electric Battery Element. G. J. Ortner, Pueblo, Colo.

561,821. Electric Railway. W. M. Schlesinger, Philadelphia, Pa.

561,828. Electric Elevator. H. R. Smith, Chicago, Ill.

561,830. Electric Railway. C. E. Stanley, Gallipolis, O.

561,838. Arc-Interrupter for Street-Car Controllers. G. Valley, Cleveland, O.

561,839. Reversing and Cutout Switch Used in Electric Street Cars, Etc. G. Valley.

561,867. Electric Motor and Motor-Generator. W. H. Cooley, Brockport, N. Y.

561,872. Electrical Accumulator. G. D. S. De Dormael, Brussels, Belgium.

561,878. Galvanic Battery. T. E. Fogalsang, Sacramento, Cal.

561,881. Electric Chime. J. H. Gerry and F. M. Schmidt, Brooklyn, N. Y.

561,886. Igniting Device for Gas or Petroleum Engines. A. A. Hamerschlag, New York, N. Y.

561,898. Electric Railway. P. W. Leffler, Chicago, Ill.

561,899. Continuous-Current Rectilinear Motor. P. W. Leffler, Chicago, Ill.

561,918 and 561,919. Electrical Measuring Instrument. H. A. Rowland, Baltimore, Md.

561,943. Electric Self-Winding Clock. R. A. Mitchell, Brooklyn, N. Y.

561,951. Electrical Connection. T. Grutting, St. Paul, Minn.